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FISHING CHIMES

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Probiotics

INDIA INTERNATIONAL SEAFOOD SHOW 2001

Indian Reservoir Fishery Devt : General Status

Fisheries Development in Wetlands of Orissa

April 2001

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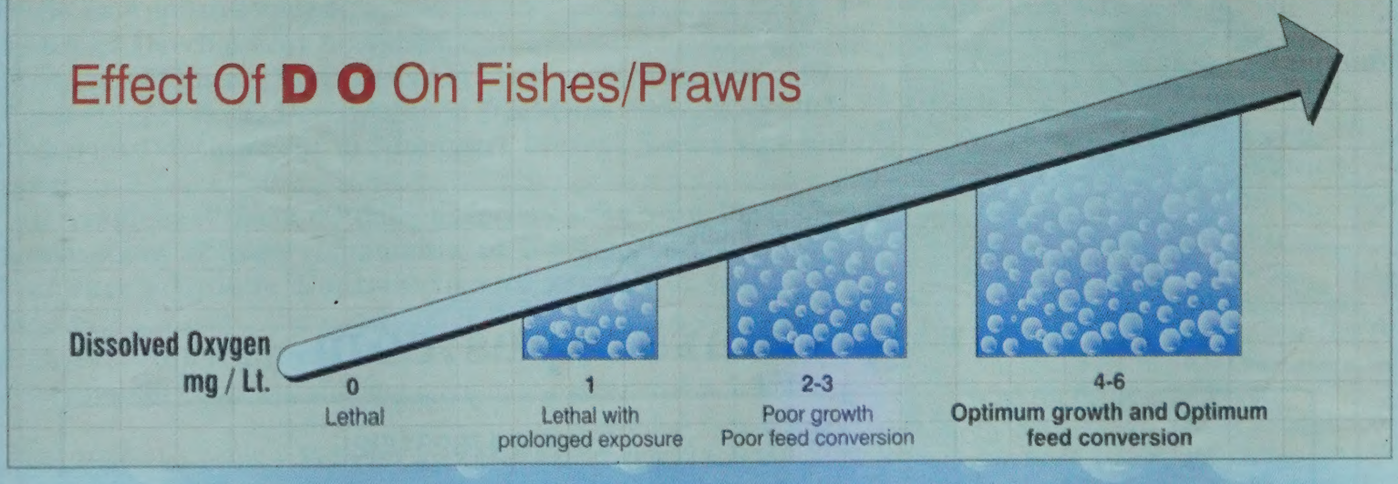

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Traversed into the 21st Volume

This issue takes Fishing Chimes into its 21st year of publication. The editor avails of this opportunity to convey on this auspicious occasion his gratitude to the journal's valued subscribers and advertisers and also to the learned contributors of papers containing valuable information on the advances made in respect of results of research, development of technologies, organisational aspects etc., besides accounts of various conferences, seminars, symposia etc., to the journal. The impact of these contributions have been significant. Fisheries officers at FAO refer often to Fishing Chimes in their work related to India. Several Indian and foreign workers also often ask for copies of papers published in the earlier issues of Fishing Chimes for reference work and these are supplied to them from time to time.

The general impression of the readers is that the journal has risen in stature with telling editorials of topical interest and with other contents rich in information pertaining to emerging technologies, developmental aspects etc. The editor conveys his heartfelt thanks to them for the perception.

The subscribers and advertisers on one hand and contributors of papers etc., on the other are the source of sustenance of the journal. Their crucial role keeps the journal going.

The category of student subscribers to the journal is on the increase. This trend is believed to be because the articles in the journal provide considerable information in the pursuit of their studies and in facing examinations.

In this issue, besides a comprehensive coverage of the INDIA INTERNATIONAL SEAFOOD SHOW 2001, we have included an excellent paper on 'Probiotics', on merits of Tilapia Culture in inland lentic waters, on reservoir fishery development, on seed production aspects of Indian river prawn (Macrobrachium gangeticus), Pabda (Ompok pabda), Indian catfish (Heteropneustes fossilis), wetland fishery development, CIFT's recently developed commercially viable products and so on. It is hoped that readers would find these inclusions, among others, to be informative.

Fishing Chimes has by now become the 'Old Faithful' of its readers. The editor seeks their blessings to build on this further.

FISHING CHIMES

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FISHING CHIMES

Forecast on Fisheries Schemes of Tenth Plan

We are now on the threshold of Tenth Plan. This threshold status tempts those interested but who are not within hearing distance of the sound and fury that signifies all that is going on in respect of finalisation of fisheries schemes of the plan, to guess what could be the likely contours and content of the plan that would be hammered out by the specialists. Having listened to a few enthusiasts who are good at the guessing game based on the trends, a formulation is attempted here to be checked later for its nearness to the actual plan when it comes out of the cod end.

It will be auspicious to begin the guessing game in respect of inland fisheries schemes likely to find a place. Starting from northern altitudes. It is possible that development of cold water fisheries would receive prior attention, may be through a scheme aimed at providing encouragement and support for the setting up of commercially-oriented integrated culture fishery units including hatcheries related to cold water fishes, principally mahseer and trout. Probably a programme of ranching of cold water streams and promotion of game fishing would also find a place in the plan with the needed emphasis on sustainability, responsible fishing, environmental safety, eco-friendly approach etc.

As they climb down from the extreme north to Punjab plains or Rajasthan desert zone, or western U.P. or Haryana, the planners may think of the great saline stretch on the north-west and ways of utilising the potential of the area for shrimp and prawn culture and for Artemia production. They may however get bogged down when they are told about the pitfalls and past experiences in respect of these lines of endeavour. Further, there can be several logistic problems that may confront them. How could the whole thing be planned, where would the money come from, how to train men, how to organise flow of seed and other inputs for culture, how to organise marketing, exports or domestic ? How to produce and harvest Artemia cysts how to pack and market them ? other issues also may come up. Development-oriented men the planners are, they can be expected to visualise the contours of the schemes and arrive at well conceived and implementable schemes that will yield viable results and shower prosperity on the farmers eventually. Pessimists, even among planners, who, alas, do exist, may pile up hundred and one arguments against the proposals. It would be interesting to know whether these projects will come up for consideration, and if so, what the result would be.

As the scanning is continued further down towards the rest of the plains and the plateau zone, the most obvious area that would strike a planner would be the need for reservoir fishery development. The developmental planners, scientists and technocrats know that without a cluster approach and an effective organisational mechanism and net-working in respect of supplies and services related to seed and other inputs, consistent operations to achieve culture - capture balance in these waters will not be possible. Further, the vital need for integration of phased harvesting, linkages with centralised cold storages/value-addition units and transportation channels and marketing linkages with domestic as well as export channels in the developmental effort is well known to the planners. Even with all these components, the task of an effective or viable reservoir fishery development is a daunting excercise. This ought to encourage and embolden intrepid planners to take on the challenge. Reservoir fishery development is a major area that has been eluding planned action. One can therefore expect reservoir fisheries development would be one of the main planks of the fisheries plan document and it would be interesting to know in what manner it would be transposed in the plan.

It is common knowledge that our wetland fisheries are the most neglected. Many are aware of the amazingly single handed achievement by G.N. Mitra a few decades back in respect of reclaiming and bringing under fish production a large number of swampy wetlands in Orissa when he was Director of Fisheries, Orissa, besides introducing measures for developing Chilka lake fisheries. What Mitra did was totally eco-friendly but his sterling work doesnot seem to have

been emulated by other States for the development of their wetlands. West Bengal and Assam have tried and they continue to try development of fisheries in their beels but not with much success. Collair and Pulicat lakes are wetlands getting increasingly eutrophic. But for converting marginal areas into fish/shrimp ponds, not much has been done for their development. In West Bengal, the Minister for Fisheries takes personal interest in wetland development but cognisible development is still at a distance. The Chief Minister of A.P. has recently exhorted villagers to desilt all tanks and ponds in disuse for storage of water. This concept can be converted into an integrated activity covering fish culture too. Agricultural fields, particularly those located in upland areas, can be desilted to the extent necessary for gathering water during rains and utilising the same for integrated paddy farming with scampi. It would be an admirable achievement if a tangible scheme for development of fisheries of wetlands finds a place in the Tenth Plan Fisheries Chapter.

One aspect that would obsess an inland fishery maniac is the manner in which the economics of operation of present pond fisheries would be sought to be improved in the Tenth Plan. Unless an alternative or an additionality to major carps is planned, taking export slant into account, not much in terms of improvement in value earnings from inland pond fishery sector, can be expected. Supplies to the North-Eastern States including West Bengal from various other States, particularly Andhra Pradesh have reached a near saturation point and a trend towards fall in prices may soon materialise. This critical situation would present a problem to be tackled. One can expect that the planners would, in all likelihood, rivet their attention towards giant freshwater prawn culture and may be also towards tiger shrimp which is now being cultured in freshwater, as value-imparting stocking additionalities that deserve consideration. Logistics of supply of seed of Scampi and tiger shrimp, which can be produced economically along the coastline only, may receive attention for incorporating an economically viable plan involving dissemination of seed supplies from the coast through a relay or networking system from production centres and also for linking the post-harvest activities with a cold chain system having centralised plants at convenient places to facilitate processing, preservation and storage for feeding domestic market with provision for organising export marketing too. Who knows, the planners may even think of recommending all this to be done in the private sector through a well-planned organisational mechanism. In any case, it would be interesting to know the manner in which they look at the subject, if it comes to their attention. One thing seems to be clear : Without bringing in the export angle, present economics of pond fishery development would not improve.

The planners are likely to be bewitched by the strides made in Punjab and Haryana in respect of integrated fish farming. What has been achieved by Punjab and Haryana farmers would deserve to be emulated by other States. Would the planning group recommend a scheme on integrated farming for application on a national basis? We will of course know once the plan document is out.

Now let us turn our attention to the marine sector. One can probably expect that a scheme for upgradation of the capabilities of the presently operational trawlers upto 15 - 16 m OAL for fishing in farther waters, along the coast line emulating Kerala/Karnataka model, would find a place in the fisheries plan. With all the clamour about tuna as the main exploitable resource available in Indian EEZ, another well thought-out scheme for promoting tuna fishing with larger vessels, in all likehood, would find a place. Problems of financing and technology transfer in respect of tuna fishing would no doubt come up for the closest consideration and a strategy to counter a possible existence of regional or global intrigues or manoeuvres to corner the bulk of the benefits out of fishing in the Indian EEZ, by known foreign interests to the detriment of Indian industry would in all likelihood be hammered out. The intentions of foreign tuna vessels to prevent Indian tuna fleets from coming up, met with success so far, but Tenth Plan strategies may counteract these overtures. It is also possible that the planning group may think of a project for providing the additionality of tuna monofilament fishing equipment on the presently operational small craft too, for the reason that monofil system is very compact and can be incorporated on them. May be the group would think of improving infrastructural facilities appropriately for post-harvest activities related to tuna exports in logistically central locations in Andamans and Lakshadweep zones and probably on the north - west too. A well thought out project that may have provision for bilateral agreements with countries such as Australia, New Zealand, USA, etc., in respect of inputs, transfer of technology, export marketing etc., would probably be thought of as India is almost totally deficient in expertise related to monofil tuna long lining system, keeping in view the past aborted efforts for placing India as one of global tuna players, which was probably because of short comings in planning .

Another aspect that may engage the attention of the planners is the imperative of introducing coastal / high sea cage culture system, supported by shore-based hatcheries. They would, in all likelihood, recommend the inclusion of a scheme on this, considering that the marine catches have reached a plateau.

Several aspects of Fisheries Education and Training would

would almost certainly receive attention under the plan, for, the implementation of the plan would depend mostly on availability of well trained personnel with hands-on experience and with a sound background of fisheries technology and fisheries personnel management, both in regard to culture and capture aspects and in regard to value - added processing and marketing in both domestic and export fronts.

Government would have to rely on private sector in a large measure for implementing the schemes that directly aim at increasing production, either from inland or marine sector. To translate such schemes into action, private sector enterprises would have to be helped with financing facility provided by a Fisheries Development Fund to be set up in the Fisheries Division of the Union Department of Animal Husbandry and also through permitting the enterprises to enter into joint ventures with genuine foreign companies, under provisions of bilateral umbrella agreements to be entered into with the governments concerned. We have to see how planners would tackle the financing problem.

Let us all look forward to the release of a unique Tenth Plan fisheries document, the first one of the new millennium.

Indian EEZ: Fishing concerns

An appraisal of the exploited fishery status of India causes concern. The result of the excercise on revalidation of resources of Indian EEZ by a Group set up by the government sounds alarming as it just confirms the earlier estimate of 3.9 million t. It is difficult to say what effect this will have on the scope for the expansion of Indian fishing fleet in the tenth plan. The only opening the validation excercise left must have been the opportunities of utilising the estimated tuna resources through introduction of related vessels. As the viability of exploitation of the limited quantities of deepsea demersal resources, other than deepsea lobsters and deepsea prawns, is not yet established, it would of great interest to know the kind of planning that would go in to utilise these resources.

Thailand, Taiwan and Korea are our main competitors in the Indian EEZ. It is common knowledge that vessels of all these countries (Probably less of them from Korea) fish in our EEZ. Coastguard or no coast guard, it is very difficult to eliminate these poachers, who are described as determined poachers. Probably they have no alternative. These countries need fish and the depletion of resources in their respective EEZs, make them compulsive and desperate poachers. Their desperation seems to be so acute that even apprehension by coast guard does not seem to be having much of an effect on them. Coast guard may succeed in apprehending a few of them, but it may not be possible to apprehend waves of these vessels coming in. The solution to the problem does not appear to lie in surviellance and patrolling alone. These activities can only be supplementary to a policy formulation that can prevent major incursions. As matters stand, Indian captains complain that Thai vessels undertake trawling in our coastal waters at depths as low as 20 m. The Nation's inability to control these incursions effectively encourages them to indulge in the continuance of practice. Probably, observing coast guard vessels navigating towards their vessels through their powerful radars and overhearing conversations on the RT, the poaches move into waters beyond the territorial waters, haul in the nets well before the patrol vessel reaches them and say, if accosted, that they are on innocent passage.

It can be said that the main reason for the upsurge in poaching is lack of presence of Indian fishing fleet in adequate strength in the Indian EEZ. The urgency now, therefore, is to expand our fleet, may be through tuna liners. The present active fleet of 60 larger vessels is too small to thwart determined poachers who are probably aware of all our weaknesses.

The easiest way of augmenting our fleet with Tuna vessels, now chosen by some of the enterprises, is to bring in Taiwanese vessels, under the sponsorship of a Japanese, Singaporean or Hong Kong companies, as Taiwan has no diplomatic relations with India. The Nation has experienced several problems of such sponsorship during the earlier Charter/ lease system. Acquisition of such vessels by Indian companies under joint ventures in the past also was found to be inconvenient, as real ownership continued with the Taiwanese. Most of the advantages went to the Taiwanese, and marginal benefits accrued to the Indian side. In short the system came to be an 'inverted' Charter / lease system and served the main purpose of securing access to the foreign vessels to fish in the Indian waters.

Government would doubt look into all these and related aspects while formulating the policy for the introduction of tuna vessels, keeping in view the fact that new vessels are prohibitively expensive and only used vessels with considerable balance of working life only can be thought of for introduction from friendly nations who can organise supply of vessels to the Indian industry through a mechanism of bilateral umbrella agreements between Indian and friendly governments. The provisions under such agreements can be for the Indian and foreign companies to enter into joint ventures which would provide for provision of vessels, training, transfer of technology, financial support and export-tie up.

Indian Events 2000 - 2001

1. National Seminar on Eco - Friendly Management of Resources for doubling Fish Production: Strategies of the 21st century. CICFRI, Barrackpore: 22nd and 23rd December 1999
2. Fifth Indian Fisheries Forum, was held at Bhubaneshwar, from 17 to 20 January 2000
3. Edible vaccine from Transgenic Fish
4. Dr. Chandra awarded Royal Society of Chemistry Fellowship and Designated Chartered Chemist by the U.K. Society
5. Dr. H.P.C. Shetty received two Fellowship awards
6. Manikfan took over as director of Integrated Fisheries Project in the place of Mr.M.K.R.Nair who took over as Fisheries development Commissioner.
7. Zoor Quasim Gold medal awarded to Dr. A.K. Pandey
8. K. Ravindranath, Director, Central Institute of Fisheries Technologies retired on Superannuation, Dr. T.S.G. Iyer took over.
9. National Workshop on Aquaculture of Freshwater Prawns was held from 8 to 9 February 2000
10. Bengal Continued to be top fish producing state in India
11. Use of Biogas slurry in Fish Culture initiated
12. National Conference on Fisheries Economics, Extension and Management, CIFE, Mumbai was held from 5 to 6 Jan 2000
13. An experiment on habitat Development for Demersal Fishery Resources n the Tidal Zone of Turicorin Bay was conducted.
14. PRAXAIR's IQF Plant installed for shrimp processing
15. Dr. S.Ayyappan took over as Director CIFE
16. CIFT took up Updated Training to fishermen in GPS and Fish Finder use.
17. Devadasan takes over as Director of CIFT
18. First National Conference on Fisheries Biotechnology was held at, CIFE, Mumbai from 4 to 5 March 2000
19. A National Workshop on "Biodiversity & Conservation of Aquatic Resources with Reference to Threatened Fish Mahseer" was held at Central Institute of Agricultural Engineering, Bhopal: 26 and 27 Feb 2000
20. Modified country craft with Inboard Engine and Winch Launched
21. Fishing Chimes celebrated 19 years of service to the Indian Fishery Industry.
22. Seminar on "Coastal Zone: 2000", was held at Hyderabad from 26 to 27 Feb 2000
23. Formulation of Deep Sea Fishing Policy: Expert group was set up
24. Tawa Matsya Sangh succeeded in the development of Fisheries in the Tawa Reservoir.
25. Best National productivity Award 1998 - 99 was given to Diamond Seafood Exports
26. Nilratan Gosh selected for Hiralal Choudhuri Gold Medal, 2000
27. National Worshop on ": Fisheries Co-operatives: Their Status and Performance", was held in Shimla on 19 May 2000
28. Mohan Joseph took over as Director, CMFRI
29. Yadava took over as Chief of BOBP
30. Seminar on Prospects of fish culture in Plateau Region of Bihar, was held in Patna on the 13 June 2000
31. Upare elevated to the rank of General Manager rank in NABARD
32. M.K.R. Nair took over as the Secretary of Aquaculture Authority.
33. Indiaseafood.net, a portal for arrangements of exporting branded exports from India, opened.
34. Yugraj Singh Yadava elevated to the position of BOBP's new co-ordinator
35. Appalanaidu's rescue act at sea gets him President's gallantry award.
36. Gujarat State Fisheries Advisory Board reconstituted.
37. Revision of Central Assistance for development of Freshwater Aquaculture was made
38. Sunit Kumar Singh bagged young scientist award.
39. Mishra of FISHCOPFED on RAB of American Biographical Institute.
40. Dr. B.N.Singh, received Dr. V.G.Jhingran, Gold medal
41. Dr.P.Das joined West Bengal Fisheries University
42. Scientist of the Year Award was given to Dr. A.K.Pandey
43. Hiralal Choudhuri felicitated with Honorary National Fellowship by the Zoological Society, Calcutta.
44. Darshan Singh received Jagjivan Ram Kisan Puraskar 1999
45. National workshop on "Bridging gaps for attaining Self Sufficiency in Inland Fish Production", Bangla Building, Calcutta: 22 June, 2000
46. National Workshop on Scombroids, was held at CMFRI, Kochi: 19 and 20 Sept 2000
47. Nita Chowdhury took over as New Joint Secretary (Fisheries) at Centre.
48. Indian Fisheries Science Congress was held at Chandigarh from 21 - 23 September 2000
49. National Workshop on the Code of Conduct for Responsible Fisheries was held at Chennai from 29 to 30 September, 2000.
50. Millennium International Mahseer Angling Festival 2000 took place in Himachal Pradesh
51. Seminar on scampi Farming was held at Raichur, Karnataka on 22 March 2000
52. Workshop on Eco-friendly and Sustainable Prawn Farming was held at Gujarat Agriculture University on 23 May 2000
53. Shrimp farmers get a new ray of hope as SC orders EIA report on its earlier order of demolition of ponds.
54. J.N.L Srivastava took over as Sectratery, Union A.H. and Dairying department.
55. PCR Diagnostic Lab Opening at Farmers Meet, Nellore, A.P.
56. Indo - French Collaboration Project on Seabass (Lates calcarifer) of CIBA, Chennai was signed.
57. Farmers meet on "Eco-friendly and sustainable Shrimp Farming, Karlapalem in Guntur Dist. Andhra Pradesh on11th Aug 2000
58. Alikunhi felicitated in his hometown in Kerala
59. Fishing Harbour at Munambam in Kerala was declared open.
60. WB Aided Project at Dadanpatrabar in West Bengal : Training course in Shrimp Culture was conducted
61. Aquaculture Authority Bill Introduced in Parliament.
62. Brainstorming session on Fisheries Education, was held at CIFE, Mumbai on Oct 20 - 21, 2000
63. Fish Farmers' Meet was held at CIFE Rohtak center on 11 Nov, 2000
64. MPEDA export awards for 1999 - 2000: (i) Highest export performance to Falcon Marine Exports Ltd, (ii) second highest performance to Nekkanti Seafood Ltd were given besides several other awards.
65. Matsya Darshan : Museum of CIFE inaugurated.
66. Tilapia boom in Asia as GIFT sparked Blue revolution.
67. Seminar on Science, technology, Coastal Zone management and Policy, Jawaharlal Nehru University was held New Delhi, Nov 17 - 18, 2000
68. National Exhibition and seminar on Sustainable Fisheries and Aquaculture for Nutritional Security, IMAGE,Chennai, 29 Dec 2000
69. First International Conference on Women in Fisheries, was held at 8-9 December 2001, Mumbai
70. Workshop on Molecular Diagnostics for Shrimp Viruses in the Asian Region, Mahidol University , Bangkok, Thailand.
71. T.S.G Iyer retired on 30 Nov 2000
72. Society for Advancement of Aquaculture and Fisheries fraternity, Bangalore felicitated Dr. Hirala Choudhuri
73. Indian International Seafood Show held at Visakhapatnam from 9-11 Feb 2001

The India International Seafood Show 2001, the 13th Biennial Seafood Trade Fair of Indian seafood industry was held from 9 to 11 February 2001 in Visakhapatnam City, located on central east coast of India. The venue of the show was the sprawling sports and culture complex of Visakhapatnam Port Trust. It was organised by the Marine Products Export Development Authority in association with the Seafood Exporters Association of India, Association of Indian Fishery Industries, A.P Shrimp Hatchery Owners Association and Shrimp Farmers Associations.

The inaugural event reflected an inspiring stance fortified by the distinguished presence of stalwarts of the industry and of dignitaries of public adoration on the dais. Besides the Union Minister, there were three Ministers representing the A.P. State Government, Mr. N. Narasimha Rao, Minister for Fisheries, Mr. Vadde Sobhanadeeswara Rao, Minister for Agriculture, and Mr. Ayyanna Patrudu, Minister for Forests. The impressive presence of a galaxy of dignitaries (Mr. M.V.V.S.Murthy, M.P and Chairman of VBC Exports, Mr. Samant Ray, M.P, Mr. K. Haribabu MLA and President, Association of Indian Fishery Industries, and Director, Coastal Trawlers Ltd, Mr. Gadde Ram Mohan, MLA, Mr. Jose Cyriac, Chairman, Marine Products Export Development Authority, Mr. Elias Sait, President, Seafood Exporters Association, Mr. Y. Suryarao, President of the Seafood Exporters Association, A.P. Region, Mr. Ranjit Bhattacharya, President of the Seafood Exporters Association, West Bengal Region and Vice-Chairman of MPEDA, Mr. Sudarsan Swamy, President, A.P. Shrimp Hatchery Owners' Association, Mr. U.K. Viswanatha Raju, President, Shrimp Farmers' Association, Mr. Prabir Sengupta, Secretary, Union Ministry of Commerce and Industries, and Mr. Bharat Bhushan, Joint Secretary, Ministry of Commerce on the dais and also at the time of the auspicious lighting of inaugural lamp by Mr. Naidu imparted a unique starting glow to the Show.

Dignitaries on the dais at the inaugaral function

Mr. M. Venkaiah Naidu, Union Minister for Rural Development inaugurated the Show on 9 February 2001 forenoon at the Kalavani auditorium of the sports complex amidst a deafening applause from an overflowing array of participants, representing various sectors of fishery industries, particularly those engaged in marine products exports and those who set up stalls. There was a strong presence of those representing sea fishing enterprises and aquaculture enterprises who produce and supply raw material to the processing and exporting segments. Their presence imparted a vibrant look to the show.

Mr.M.Venkaiah Naidu, Union Minister for rural development inaugurating the seafood show by lighting the traditional lamp. To his left are the A.P. ministers, Mr.N.Narsimha Rao, minister for fisheries and Mr.V.Sobhanadeeswara Rao, minister for agriculture, and to his right are Mr. Ayyanapatrudu, minister for forests and Dr. K. Haribabu, M.L.A and President, AIFI

Welcome Address: Mr. Jose Cyriac, welcoming the dignitaries on the dais and the distinguished participants, thanked the co-organisers, SEAI, AIFI, A.PShrimp hatchery owners' Association, and Shrimp Farmers' Association for their concerted action

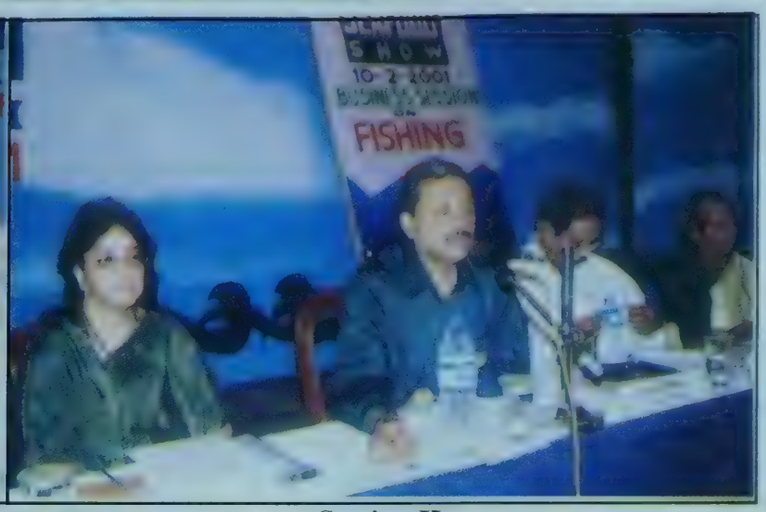
which had contributed in an abundant measure to the organisation of the Show. He said that it was no small achievement that exports for the year 2000-01 upto

socio-economic status of fishermen and farmers. He complimented Andhra Shrimp farmers who contributed as much as 50% of the exported quantities and Rs.

would take time, it was planned to set up a shrimp nauplii-production centre in Andamans in the meanwhile as a short-term measure.

DIGNITARIES ON THE DAIS AT THE BUSINESS SESSIONS

Session 1



Session II

Session III

Session IV: Dr. Shashi Sareen, Director, EIC speaking

Dec 2000 reached a level of Rs. 5117 crores (US $ 1189 million) and were poised to set a new record of Indian marine products exports by March 2001. There had been an increase in unit value of exports and this had enabled exporters to pay the best price to the fishermen and farmers for their produce. He also added that this was a welcome development as it had contributed to the

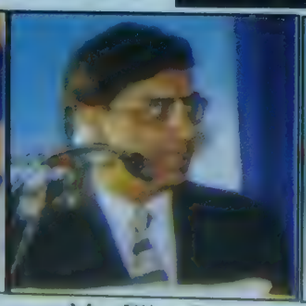
2000 crores to the total foriegn exchange earnings from marine products exports.

The Chairman referred to the problems being faced in respect of shrimp aquaculture. One was the scanty availability of disease-free brooders. A project was being taken up to resolve the problem. As the materialisation of the project would take time, it was planned to set up a shrimp nauplii-production centre in Andamans in the meanwhile as a short-term measure.

Touching on the hardship to the farmers because of the high import duty on Artemia, Jose Cyriac gave the good news to the hatchery owners that the duty reduction aspect was being favourably considered by the Ministry of Finance. He called upon the state government to waive or reduce tax burden related to diesel oil etc., which was causing hardship to fishing community. He

Some of the distinguished speakers

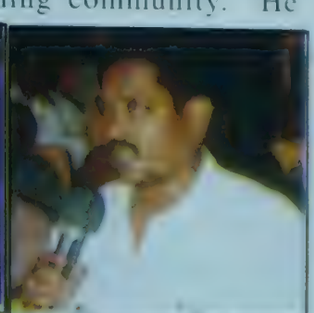
Mr.M.V.V.S. Murthy



Mr. Elias Sait

Mr. Prabir Sengupta

Dr. V.S. Somvanshi



Mr.V. Vasanth Kumar

urged upon the participants to dispel the misconception that marine products exporters were doing well. For the exporters the increase in export prices was not commensurate with the surging expenses and this situation was pulling them into financial losses. In view of this, MPEDA was making efforts to set up a Rehabilitation Fund. Concluding his address, he once again extended a warm welcome to the Ministers and other dignitaries on the dais individually. He articulated special words of welcome to the foreign delegates, particularly to the awardees under 'Friends of India' category, and also to the other awardees all of whom would receive the awards on this occasion. Mr. Cyriac lauded the services rendered by Late Mr. C. Cherian as President of Seafood Exporters' Association for 30 long years and also as Vice-chairman of MPEDA for long. He left the mortal world in 1999 and his death was a great loss to the industry. He would be posthumously honoured on this occasion and the award would be handed over to his son, Cyriac added.

Vice-Chairman's Report : Mr. Ranjit Bhattacharya, Vice-Chairman of MPEDA presented a Report. Pointing out that only around 40,000 ha of coastal lands out of 1.5 lakh ha had been brought under shrimp farming and that only around 100 large trawlers were being operated for exploiting the immense marine fishery wealth of the Indian EEZ, he highlighted the need for instituting intensive measures for the exploitation of known resources. Saying that the present level of marine products exports, now on their move towards Rs. 6000 crores mark, could be stepped up to a level of Rs. 25,000 crores through promotion of export-oriented aquaculture across the length and breadth of the country. He pleaded for the enactment of the Aquaculture Authority Bill, and for stipulating a code of conduct for hatchery operations and aquaculture. Speaking on marine capture fishery sector, he pleaded for upgradation of fishing capabilities of the vessels now being operated by provision of additional systems of fishing to enable them to operate throughout the year and not seasonally as at present. He wanted small mechanised boats to be supplied with diesel oil without excise duty and sales tax. He was unhappy that, while allowing high sea bunkering facilities to larger vessels and thereby enabling them to avoid levy of excise duty and sales tax, small craft are subjected to taking bunker with duties. He said that this was injustice. He pointed out that diesel oil was a basic raw material for the fishing industry and not an alternate source of power as in other industries. He wanted the equity base and financing facilities to the fishery industries to be augmented. Concluding, he made an appeal to the authorities to provide upgraded infrastructure facilities all along the coastline for hygienic post-harvest handling of fish catches and for value-addition. He exhorted the marine products exporting community to take a vow to step up earnings from exports of marine products from the present level to Rs. 15,000 crores in three years.

Presidential Address : In his presidential address, Mr. Prabir Sengupta, Secretary, Union Ministry of Commerce said that he looked forward to positive developments in respect of Aquaculture Authority Bill. Pointing out that the growth scenario of marine products was at a critical stage, he spoke in favour of corporate medium term strategies for further augmenting marine products export growth to be put in place in the next three years. Emphasis was laid on value-addition and on responsible capture fishing and culture practices. Saying that there was tremendous scope for increasing production, he pointed out that tuna resources of Indian EEZ were only marginally exploited by the Indian industry. With aquaculture having entered the scene and demonstrated its potential and growth dimension, a viable opening had now presented itself to convert the earlier inelasticity into an elastic scenario, and mobilisation of all efforts to achieve this was needed, he observed.

Brand Name Adoption : He explained to the participants the merits of association with a good brand name and exhorted them to utilise the facilities available under the Brand Equity Fund set up recently. A major facility under the Fund that could be availed of was the adoption of a reputed foreign brand name by Indian firms.

Fishery Reconstruction Fund : He also said that a Fishery Reconstruction Fund would be set up soon and added that the operational details were to be worked out. He further mentioned that the availability of financial assistance under the fund should not be a problem.

Mr. Vadde Sobhanadeeswara Rao released the Show Souvenir. Speaking thereafter, he expressed his happiness that the Show was being held at Visakhapatnam, which was the outlet of exports of marine products from the State, particularly culture shrimp, in the production of which A.P was in the forefront. He told the audience about the new developments in the State in respect of Scampi culture, particularly in Nellore district in about 20,000 ha, and culture of tiger shrimp in freshwater in the Central Coastal Districts of West Godavari and Krishna in about 2000 ha. Referring to the disease problem, he suggested introduction of quarantine system to prevent import of diseased seed from other countries, which was being resorted to by some enterprises. He expressed unhappiness that NABARD was not extending refinancing facility for aquaculture and that insurance companies stopped crop insurance. He wanted the ministry of finance to look into these unfortunate developments.

He suggested to MPEDA to work out a system and implement the same for regulating inlet and outlet operations related to shrimp ponds and extend suitable advice to farmers, most of whom were small scale farmers, to produce quality shrimp and scampi. He also confirmed the support of most of the coastal state governments for the passage of the Aquaculture Authority Bill in the Parliament.

Mr. M.V.V.S. Muthy, in his felicitation address, highlighted the instant need for the exploitation of tuna resources of Indian EEZ and also made a focal reference to the crucial requirement of setting up of fishing harbours at Lakshadweep and Andaman islands. Pointing out the need for promoting onboard processing, he pleaded for providing adequate infrastructure facilities for being used by small scale fishermen too. Dwelling on the dis-

case problem that had engulfed black tiger culture sector. he laid emphasis on the need for developing domesticated shrimp brood stocks for use at hatcheries to produce post-larvae.

Mr. N. Narasimha Rao, Minister for Fisheries, A.P. in his felicitation address, complimented MPEDA and the co-organisers for mounting such a mega show, the first of this kind in the millennium in the Indian fisheries sector. He said that A.P had set a fish production target of 10 lakh t per annum to be achieved by 2020 through culture and capture fishery intensification.

Inaugural Address : Mr. M. Venkayya Naidu, in his address after inaugurating the show by lighting the traditional lamp, lent support for the conversion of paddy fields for scampi production, which gave better incomes to the farmer, without upsetting the soil or environmental character. He observed that aquaculture could bridge the divide between urban and rural sectors. The activity could augment rural wealth. He announced that, as a rural development minister, he supported rural aquaculture including integrated aquaculture in paddy fields and coastal aquaculture. It was unfortunate that, out of 1.4 million ha of tanks and ponds available for fish culture, only 1/10th of the area was put to use. In the coastal sector only 40,000 ha were brought under production against 1.5 lakh ha of coastal area available. Despite these features he was happy that, with the advent of aquaculture, fishermen's incomes increased and consequently their standard of living went up. He spoke with a forgiving tone about the misguided / misinformed persons / organisations who had been speaking against aquaculture activities, referring to them as environmentally unsafe. If they felt that the activity was not eco-friendly they should come up with ideas to strengthen the activity and to eliminate the short comings perceived. He expressed the view that, with a good measure of encouragement, the fishermen and the farmers could step up their performance and excel.

Fleet Expansion **:** He felt that allowing the national fishing fleet to stagnate when there were known unexploited resources such as tuna in the Indian EEZ was something to be unhappy about. He wanted that immediate steps be taken to augment fishing fleet with vessels designed for catching exportable resources.

Steps for promoting Development **:** He advocated the following other steps. 1) Promoting joint ventures to produce and export value-added packs with well known brand names of the joint venture partners or others as the case may be; 2) Export of retail packs, made attractive to the buyers, has to be promoted, with popular brand names, rights over which could be secured, either as joint ventures or other-wise; 3) Cartons used for export should be of high standard; 4) Laboratories to test quality of freshness should be added to the processing plants where they are not there now; 5) Catching and storage / on board processing and packing techniques have to be improved; 6) MPEDA could step up its role to augment raw material production through improvements in development strategies of capture and culture fisheries; 7) Measures of conservation should be enforced to lend protection to brooders, 8) An enduring system of studies to understand market mechanisms and trends needs to be evolved and activated and 9) Consortium approaches deserve to be adopted for pooling up catches for export, securing bargaining leverage and achieving savings in costs.

Speaking on Aquaculture Bill, the minister said that there was a consensus on the need for the bill. He assured that he would pursue the matter in the cabinet. He said that certain people were conducting anti-propaganda which was not vindicated by facts as perceived in the field.

Common Cold Storage Facilities **:** Stating that the middlemen were exploiting the farmers and fishermen, he said that this was happening because of inadequate common cold storage facilities. Considering this, government of India had decided to promote cold storage facilities to the extent of 12 lakh t capacity in the country in the private sector with provision of 12% subsidy. He appealed to the farmers to conduct aquaculture in a sustainable manner and thereby contribute to the rural economy. This called for upgradation of skills needed, he added. Concluding, the minister congratulated MPEDA, AEA, Hatchery Owners' Association, Seafood Exporters Association and, Farmers' Association for organising the Show so well. He added that Visakhapatnam city itself deserved to be congratulated for hosting the Show and he gave an assurance of his ministry's support in their endeavour to solve the problems confronting them.

AWARDS : Awards for those identified as 'Friends of India' and such of those companies who were adjudged as outstanding in their export performance were presented by Mr. M. Venkayya Naidu. The awards under 'Friends of India' category were given to three outstanding importers of Indian marine products. These were :

1) M/s Landauer Ltd (Seafoods's Division), U.K., 2) M/s Red Chamber, USA, and 3) M/s Hanwa Co Ltd, Japan.

A life-time achievement Award, given posthumously to late Mr. C Cherian, was handed over by Mr. Ayyanna Patrudu, Minister for Forests, Govt of A.P to Mr P.C. Cherian, son of late Mr. C. Cherian.

MPEDA's awards to companies that achieved outstanding performance in 1998-1999 and 1999-2000 were handed over to the respective companies by Mr. M. Venkayya Naidu as detailed hereunder.

A. Crown Frozen Foods, 203, Dalamal Chambers, New Marine Lines, Mumbai 400 020.

1. Award for the highest performance in overall exports: Category I 1998-99.

2. Award for the highest performance in the export of frozen cephalpods - Category - II (ii) : 1998-99 and 1999-2000.

3. Award for the second highest performance in the export of forzen shrimp, Category - II (i) : 1998-00

4. Award for the second highest performance in overall export Category - I; 1999-2000.

The company also won National Award for exports, during 1986-87 and 1991-92.

(Continued on page 21)

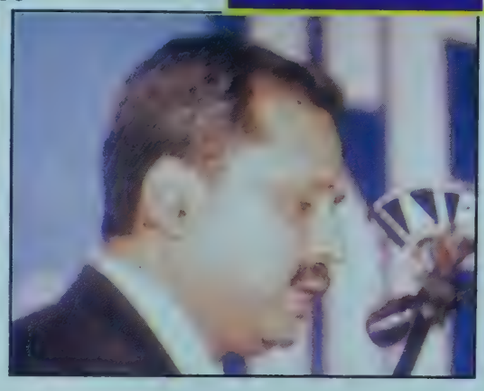
A section of Audience

Other Distinguished speakers at the Business Session

Prof.(Dr.)K.Gopal Rao

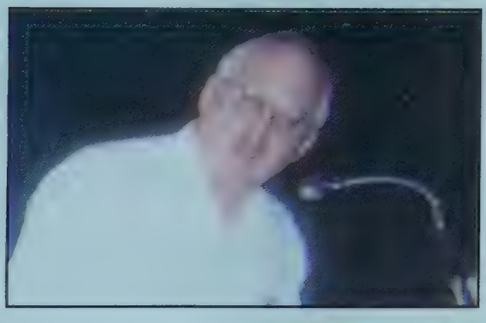
Prof.(Dr.) I. Karunasagar

Ms. Nita Chowdhury

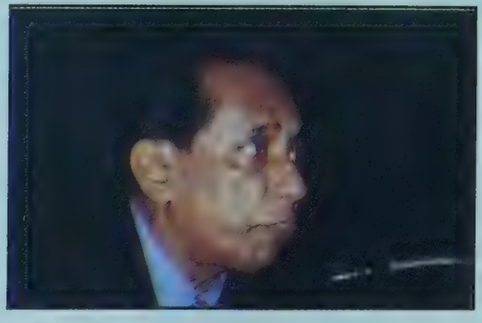


Mr. Jose Cyriac

Mr. M.M.Lateef(General Manager), State Bank of Hyderabad

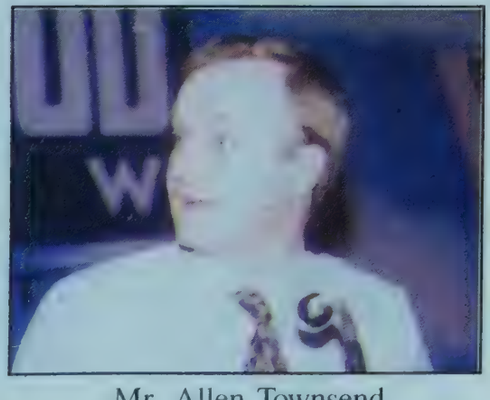


Mr. Howard M. Johnson



Dr. Subasinghe

Dr.J.Bhojan, Joint Director MPEDA



Mr. Allen Townsend

Mr. M.Shimomura

MPEDA Awards

For Outstanding Marine Products Export Performance, 1998-99 & 1999-2000

Friends of India Awards 1999-2000

Mr. M. Venkaiah Naidu, presenting Awards to.....

Mr.Stephan Brown, Director, M/s.Landauer Ltd., (Seafood's division,London U.K.)

Mr.Ming Bin Kou Exec. Vice-President M/s Red Chambers Company Vernon, U.S.A

Mr. A.Ohtaguro, Deputy Manager, M/s Hanwa Co. Ltd., Tokyo, Japan

Niranjan S.Mathani of Crown Seafoods: Hightest Performance (Overall Exports)

Mr. Tara Ranjan Patnaik of Falcom Marine Exports: Second Highest Performance (Overall Exports)

Mr.N.S.R Murthy of Nekkanti Sea foods: Second Highest Performance (frozen shrimp)

Ramesh K.Cham of Cham Cold storage: Second Highest Performance (Frozen Cephalopods)

K.H.Saleem of Baraka Sea Foods: Second Highest Performance (Frozen Cephalopods)

S. Tajuddin of Amar Cold storage Highest performance (Frozen Finfish) 1998-99 and others

MPEDA Awards

For Outstanding Marine Products Export Performance, 1998-99 & 1999-2000

Mr. Vipul K.Agarwal of Excel Ice Services: Highest Performance(Export of fr. /Chilled fish) 1999-2000 and others

Mr. J.V.Satyanarayana of J.V.S Exim: Highest Performance (Chilled fish) 1998-99

Shoukathali Ansari of Chand International: Second Highest Performance (Chilled Fish)

Mr.Deepak Nopany of Asian Exports: Highest Performance (Aquarium Fish) 1999-2000

Mr. Zikar Hazi Mohamed of National Seafood Corporation: Highest Performance (Dried Marine Products)

Mr. Samar Uppal, Dragon Fisheries Ltd.,: Highest Performance (Deep Sea Fishing) 1999-2000

Mr. T. Raghunath Reddy of Suvarnarekha Marines: 2nd Highest Performance (Deep Sea Fishing)

Mr. A.J. Tharakan of Accelarated Sea Foods: Export of Value added products

Mr. Sudher Ranjan Das of B.S. Seafoods: New products

Representative of Aqua Decor : Second Highest Performance (Live aquarium fish)

Mr. P.C. Cherian, receiving the posthumous award given to his father Late Mr. C.Cherian for his life time contribution to Marine products export sector, from Mr.Ayyana Patrudu, Minister A.P.

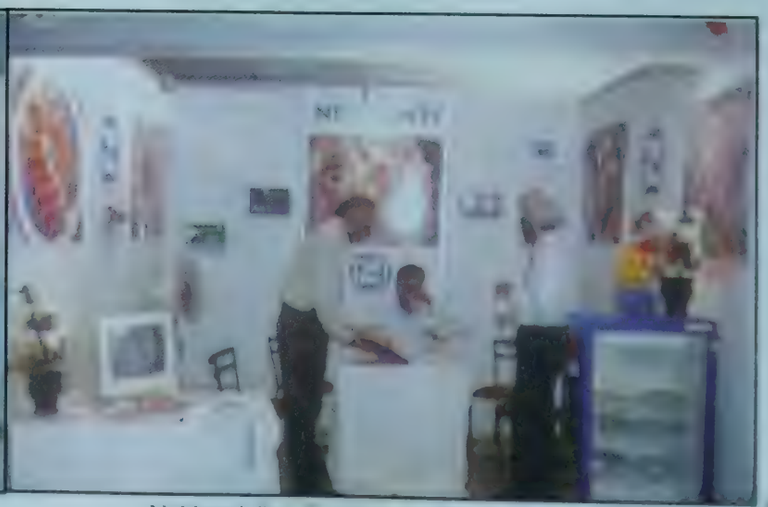
Exhibition

Mr. M.Venkaiah Naidu inaugurating the exhibition, flanked by Mr.Jose Cyriac, Chairman, MPEDA,and Mr.Prabir Sen Gupta, Commerce Secretary.

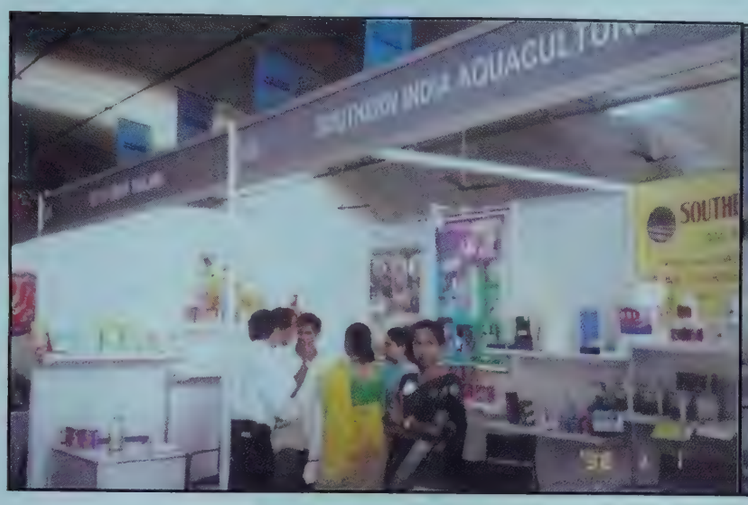
Mr. M.Venkaiah Naidu displaying the Seafood Show special issue of *Fishing Chimes* at the stall of AIFI, after its release by him.

Stalls

Wockhardt Ltd., Mumbai
Tel: 022-6534444 ; Fax; 6534242;
E-mail:shabu@wockhardtin.com



Nekkanti Sea Foods Ltd., Visakhapatnam
Tel: 0891-567878; Fax 567226;
E-mail: asreeram@vsnl.com

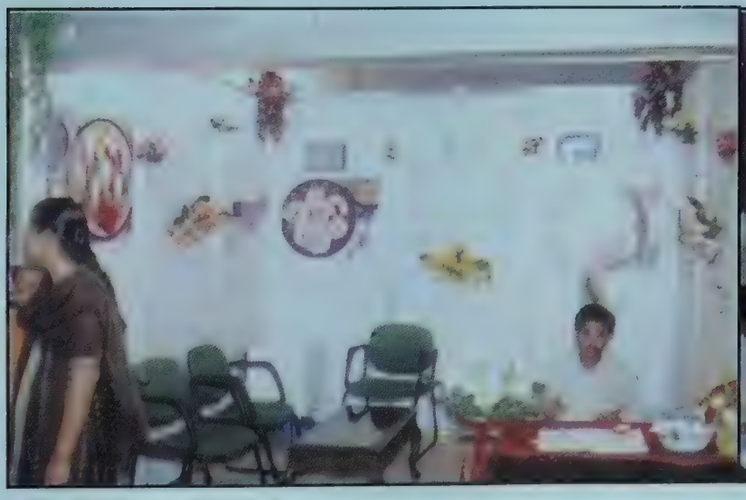


Southern India Aquaculture, Chennai
Tel: 044-8255825; Fax:8259524
E-mail: siac@eth.net

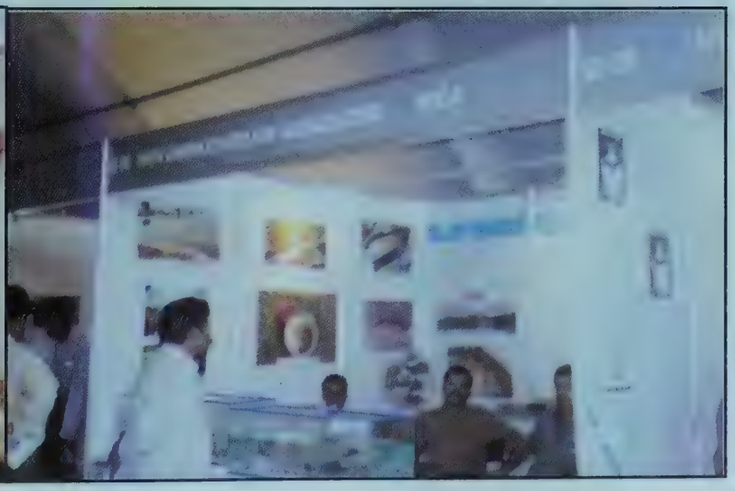
Higashimaru Feeds(I) Ltd.,Cochin
Tel: 668680/0484-562470; Fax 668130/668133/0484-562747
E-mail: hfilkut@md3.vsnl.net.in

Waterbase Ltd., Chennai / Kerry Ingredients U.K.Ltd.,
Tel: 044-8113682/8110684/8113 682; Fax: 044-8113681
E-mail:waterbase@vsnl.com

Suvarna Rekha Marine Exports Ltd., Visakhapatnam
Tel: 502858,714019,567761 Fax:0891-562504
E-mail:srml@excite.com

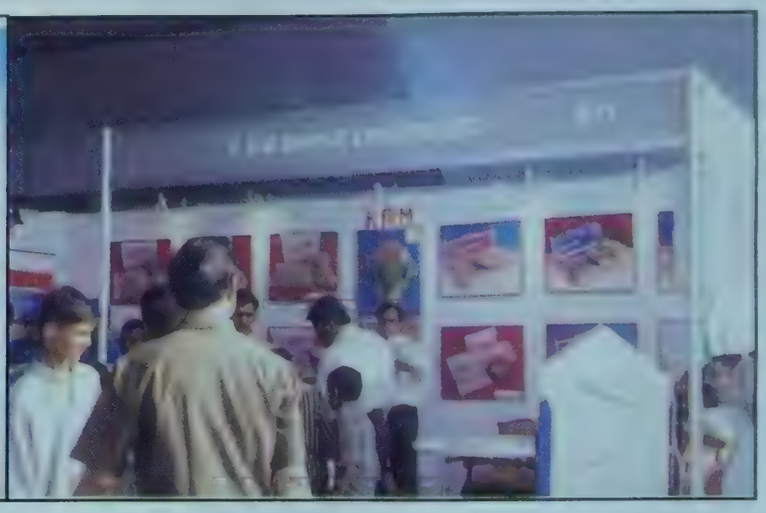


Sandhya Marines Ltd., Visakhapatnam
Tel: 0891-56416; Fax 567226
E-mail:sandhyamarines@yahoo.com



Rajiv Gandhi Centre for Aquaculture, Tamil Nadu
Tel: 04364-26226; Fax:04364-25584

Sawant Food Products Ltd., Thane, Mumbai
Tel: 022 - 5377925
E-mail:sawantfp@bom3.vsnl.net.in



K.R.M.Marine Exports Ltd., Chennai
Tel: 044-6212183; Fax-044-6262528
E-mail;krm2@vsnl.com

San Miguel Foods, Phiilipines/Dhananjaya Impex P Ltd., Hyd.
Tel: 3308034; Fax:6615466
E-mail:dhanam@nd1.vsnl.net.in

Garware Wall Ropes, MDIC.Chinchwad, Pune
Tel: 020-7473931/32; Fax:020-7470141
E-mail: domestic@garwareropes.com

Mr. Y.Surya Rao President, SEAI Visakhapatnam region, conversing with Mr.M.Venkaiah Naidu, Union Minster for Rural Development

Devi Fisheries Ltd., Visakhapatnam
Tel: 564204; Fax: 563863
E-mail: devifish@md4.vsnl.net.in

B. Falcon Marine Exports Ltd, A/22 Cuttack Road, Falcon House, Bhubaneswar, Orissa 751 006.

1. Award for the second highest performance in overall exports; Category I : 1998-99.

2. Award for the highest performance for the export of frozen shrimp; Category - II (i) : 1998-99 and 1999-2000.

3. Award for the highest performance in overall exports; Category I : 1999-2000.

(The company has been winning MPEDA's export award for the highest performance for export of frozen shrimp since 1996-97.)

C. Nekkanti Sea Foods Ltd., No. 1, Jayaprada Apts., Nowroji Road, Maharanipeta, Visakhapatnam-530002.

Award for the second highest performance for export of frozen shrimp; Category - II (i) : 1999-2000.

(The company won MPEDA's Award for outstanding export performance in Deepsea Fishing during 1996-97.)

D. Cham Ice and Cold Storage, Bokhina, Porbandar, Gujarat - 360 575.

Award for the second highest performance for export of frozen cephalopods; Category II (ii) : 1998 - 99.

(The company was the winner of the second highest performance award in overall export during 1996 - 97 and 1997 - 98.)

E. Baraka Overseas Traders, P.B. No. 1204, Beach Road, Ullal - 574 159, Mangalore, Karnataka.

1. Award for the second highest performance in export of frozen cephalopods - Category II (ii) : 1999 - 2000.

(During 1999-2000 the company exported marine products to Jordan, a new market. They won the second best export award of National Productivity Council, New Delhi in 1997-98.)

F. Amar Cold Storage, Jawar Naka, Porbandar, Gujarat - 360 575.

Awards

1. Award for the highest performance in the export of frozen finfish; Category II (iii) : 1998 - 99.

2. Award for the second highest performance in the export of frozen finfish; Category II (iii) - 1999 - 2000.

G. Excel Ice Services (Chirag Group of Companies) 'Chirag House', Plot Nos. 27-29, MAFCO Compound, APMC Yard, Vashi, Navi Mumbai.

1. Award for the second highest performance in the export of frozen fish; Category II (iii) : 1998-99.

2. Award for the second highest performance in the export of Chilled fish; Category Ii (iv) : 1998-99.

3. Award for the highest performance in the export of frozen finfish; Category II (iii) : 1999 - 2000.

4. Award for the highest performance in the export of chilled fish; Category II (iv) : 1999 - 2000.

The company won MPEDA award in 1996-97 under the category - II (iv) - chilled fish.

H. J.V.S. Exim (Pvt) Ltd, 10/290, 2nd lane, Rajendra Nagar, Gudivada-521301, A.P.

Award for the highest performance in the export of chilled fish; Category II (iv) : 1998 - 99.

(J.V.S. Group won the award during 1997-98 also.)

I. Chand International, 14, 3rd Floor, CSM Fish Market, Palton Road, Mumabi - 400 001.

Award for the second highest performance in the export of chilled fish; Category II (iv) : 1999-2000.

J. Goodwill Exporter, P.B.No. 46 (old No. 84) New No.8, 1 Yappa Chetty Street, Chennai - 600 001.

Award for the highest performance in the export of dried marine products - Category II (v) : 1998-99.

The company received similar award for 1997 - 98 also.

K. National Seafood Corporation, Sewri Cross Road, Sewri, Mumbai - 400 015.

1. Award for the second highest performance for the export of dried marine products; Category II (v) : 1998-99.

2. Award for the highest performance in the export of dried marine products; Category II (v) : 1999 - 2000.

L. Marine Mercantile Company, 30, Maracoir Labbi Street, Chennai - 600 001.

Award for the second highest performance in the export of dried marine products; Category II (v) : 1999 - 2000.

M. Madras Seafoods, Old No. 6, New No. 4, Singanna Street II lane, Chintadriput, Chennai - 600 002.

Award for the highest performance for the export of live seafoods other than aquarium fish; Category III : 1998-99 and 1999-2000.

(They have exported live mud crab with Rs. 6.97 crores during 1998-99 and Rs. 7.88 crores during 1999-2000.)

N) Scanet Exports Limited, 47, Sterling Avenue, 1st Floor, Nungambakkam, Chennai - 600 034.

Award for the second highest performance in the export of live seafoods other than aquarium fish; Category III : 1998-99.

(They have exported live marine porducts worth Rs. 4.35 crores during 1998-99).

O) Asian Exports, 200/2A Rashbehari Avenue, Kolkata - 700 029.

Award for the highest performance in the export of aquarium fish; Category IV : 1998-99 and 1999 - 2000.

P) Aquadecor. 77, Netaji Subhas Raod, 1st Floor, Room No. III, Kolkota - 700 001.

Award for the second highest performance for the export of live aquarium fish; Category IV : 1998 - 99.

Q) Dragon Fisheries Ltd, 1st and 2nd Floor, V-7, Green Park, New Delhi - 110 016.

Award for the highest performance in deepseafishing Category V : 1998 - 99 and 1999 - 2000.

(This is the fourth consecutive award received by the company from MPEDA.)

R) Suvarna Rekha Marines Pvt Ltd., Ocean Park, Maharanipeta, Beach Raod, Visakhapatnam - 530 002.

Award for the second highest performance in deepsea fishing Category V : 1998 - 99 and 1999 - 2000.

(The company is the winner of this award for the third consecutive year.)

S) Accelerated Freeze Drying Company Ltd., Amalgam House, Bristow Road, Willingdon Island, Cochin - 682 003.

Award for the special efforts made to increase the export of value - added products. Category VI : 1998 - 99 and 1999-2000.

(The company has been winning MPEDA award continuously for the fourth time.)

T) B.S. Sea foods Pvt. Ltd., 12/1 Jessore Road, Duck bangalow More, A.C. Market, Barasat, 24 Parganas (North) West Bengal.

Award for the special efforts made to increase the export of new products; Category VI : 1999 - 2000.

(They won the MPEDA Award for the second highest performance in the export of dried marine products during 1997 - 98.)

U) The Award given posthumously to late Mr. C. Cherian, an outstanding ex porter and President of Seafood Ex porters Association for decades, was handed over to his son, Mr. P. C. Cherian.

The Organisers presented memontos to Mr. M. Venkayya Naidu, Mr. Pradip Sengupta, Mr. Vadde Sobhanadeeswara Rao, Mr. Ayyanna Patrudu, Mr. N. Narasimha Rao, Mr. M.V.V.S. Murthy, Mr. Y. Surya Rao and others.

Mr. Elias Sait, President, Seafood Exporters Association proposed a vote of thanks.

Business Session I

This session, on aquaculture, was chaired by Mr. T.K.A. Nair, Chairman, Public Enterprises Selection Board, New Delhi. It provided a wealth of information. Mr. Les Rodgers made an illuminating presentation on culture of grouper and seabass, with emphasis on hatchery production of their seed. Dr. G.R.M. Rao, Director, CIBA, spoke on sustainable aquaculture of shrimps and the policies and programmes of the government related to the activity. Prof. (Dr.) K. Gopal Rao, Principal, College of Fisheries, Nellore, A.P, delivered a highly informative talk on the present and future of freshwater prawn culture. Explaining the technologies and the status of their adoption by several farmers who had diversified into prawn culture, he forcast a bright future for freshwater prawn farming, while also indicating the constraints and the steps needed to get over them.

Prof.(Dr.)I. Karunasagar of Department of Microbiology, College of Fisheries, Mangalore presented a paper on disease problems in shrimp aquaculture : Their prevention and control, authored by himself and Indrani Karunasagar. Explaining the strategies to avoid pathogens, the technique of diagnosis of disease, and use of probiotics to eliminate pathogens, he delineated the methods to boost the natural defence system of shrimp. Strategies to improve water quality and for reduction of stress to shrimp under culture, and development of probiotics were also covered by him. Research needs to help disease control among carps under culture were also mentioned by him.

Several points were raised by the participants in respect of the problems faced by them in their aquaculture operations related to shrimp and scampi which were answered by the authors of the papers.

Business Sesson II

This Session, chaired by Mr. K. Jose Cyriac, Chairman, MPEDA, dealt with the fishing sector. Formally introducing Ms. Nita Chowdhury, Joint Secretary (Fisheries), Union Ministry of Agriculture to the participants, and saying that she would speak on various aspects of marine fishing industry while also providing clarifications on several issues raised by the farmers at session I, he said that, as Joint Secretary (Fisheries) in the Ministry of Agriculture, the main Co-ordinating Agency of Fisheries developmental effort under various ministries, he said that she was performing the formidable task of homogenising the points of view of a multipicity of organisations, which sometimes worked at cross purposes. A centrist approach had to be adopted and Ms. Chowdhury was face to face with this requirement. He pointed out how crucial the role of Fishery Survey of India was and this was being handled eminently well by her and the work entailed co-ordination with CMFRI and other institutes of ICAR. Mentioning that Ms. Chowdhury, of IAS cadre of UP, enjoyed the unique distinction of having vast experience in fisheries development by virtue of holding top fisheries posts in UP, he expressed confidence that, during her tenure of five years as Joint Secretary, Fisheries, she would usher in a new era of national fisheries development. A little known fact he told the audience was that Ms. Chowdhury held a doctorate degree in political science.

Cyriac also introduced the speakers at the Session, Dr. V.S. Somvanshi, Director General, Fishery Survey of India and Mr. J.V.H. Dixitulu, Editor, Fishing Chimes.

The Chairman highlighted the remarkable transformation now taking place in the mechanised boat operation sector. The boats were now being equipped by the operators with GPS, fish finder, RT and mobile phones. The boats now undertook multi-day fishing, carrying ice. Surprising by, the operators were no longer interested in subsidy for equipping their boats with GPS etc. Their interest was in acquiring technology. Referring to deepsea fishing, he said that it was a great advance that Indian deep sea trawlers were now fishing in Myanmar and Indonesian EEZ.

The Chairman, while laying emphasis on responsible and sustainable fishing, expressed himself against introduction of eco-labelling immediately, although the concept was important. However, should it be necessary, the exporters should be prepared for it, he added. He also mentioned that effectuation of responsible fishing called for a voluntary code of conduct and also required policy

changes.

Dwelling on conservation aspects, he subscribed to the general consensus that Indian coastal waters were overfished and needed fishing holiday. In Kerala and several other States fishing ban during monsoon season was there. He pleaded for a uniform period of conservation. At the same time, he voiced the common perception and general concern that tuna resources of Indian EEZ were not touched at all.

Nita Chowdhury made an extempore presentation that covered, in the main, eco-labelling, coastal zone, Indian deepsea fishing situation, resource-specific fishing, Indian Ocean Tuna Commission and Conservation aspects. She said that on 13/14 Feb 2001 a meeting was held on WTO standards on eco-labelling, in this regard. The tendency at the meeting was to impose the view of developed countries on others. The views expressed at the meeting were divergent and none of them were acceptable to India as the views did not cover standards but emphasised mainly on international mechanism to monitor the labelling system. In the name of conservation many things to govern eco-labelling were proposed. Different waters had different problems of eco-security (The species that needed protection were identified by Silas Committee in 1987) and this had to be reflected in the convention, Indian representatives felt. Owing to short comings of this nature, 41 countries including India had not signed the convention, she said. It was also mentioned that eco-labelling papers as related to the conference and the convention would be sent to MPEDA for its comments as MPEDA's input in this regard was of vital importance.

Regarding the Coastal Zone, government received several petitions against Aquaculture Authority Bill from Tamilnadu and Kerala, only to be followed by several other petitions supporting the Bill from Andhra Pradesh. These were taken into account but the need was for the stake-holders, who were all partners in the developmental endeavour to develop a consensus, so as to ensure sustainable development.

Dwelling on deepsea fishing (fishing beyond the Coastal Zone), she said that beyond 50 m depth zone of the Indian EEZ with 1.69 million mt of resource, only 25% was harvested. It had to determined, so far as exploitation of bottom resources was concerned, whether to have additional fleet or measures to be instituted for optimisation of the efficiency of the present fleet. It was observed that there were some who demanded increase in the fleet and some others who supported the optimisation concept. A balance between the two approaches had to be probably worked out, she said.

The Joint Secretary referred to the essentiality of resource-specific fishing for pelagic species like tuna which commanded a good export market. The available resources of tuna were not being exploited by India now. In order to fill up this gap she was glad that MPEDA had take up a pilot project of tuna longlining to pave the way for tuna fishing. She apprised the participants about the opinion expressed against operation of purse seines for catching tuna (at an IOTC meeting held recently in Seychelles) because of the destructive nature of these nets. She added that even Japan was against operation of purse seines for catching tuna.

Nita Chowdhury highlighted the need for effective management of Indian fishery resources. In this context she referred to the observation of Silas Committee that Indian marine production reached a plateau. Oil sardine and mackerel catches declined to a disastrous level, and so was the case with several other resources. There was only a minor increase in the production of certain species. She felt that measures to ensure sustainability of fishing, particularly off Orissa, West Bengal, Kerala and Tamilnadu coasts were imperative. All coastal States, with the exception of Gujarat, were implementing MFR Acts and she hoped that Gujarat also would soon fall in line. She expressed her unhappiness that several of the companies which were permitted to operate chartered vessels did not comply with the *pari passu* condition. Further, substitution of foreign crew with Indian crew did not take place.

In this background, she was clear about certain option to be excercised. One was related to promotion tuna longline fishing and squid jigging outside 100m depth zone. The quantum of deepsea lobster and prawn that could be exploited from known grounds would have to be arrived at for the benefit of industry and exploration to locate new grounds for these species would need to be stepped up, she observed. Regular voyage reports of each of the fishing vessels would have to be obtained as was being done in countries such as Japan, and Indonesia. Code of conduct for responsible fishing had to be introduced and popularised, it was added.

It was explained that, fishes being an exploitable resource, drop in catches once in a few years, and no drop in any of the resources other than oil sardine and mackerel in some years was noticed.

It was pointed out that an institutional framework was needed for ensuring proper implementation of conservation measures and also to monitor imports of exotic species. She said that quarantine measures to be introduced would soon be discussed and finalised.

Several questions raised were answered by the Joint Secreatary. She said that government of India would be issuing a notification, similar to the one issued by the coastal governments, declaring closed season beyond territorial waters too. It was also clarified that deepsea area was defined as commencing from the edge of contenental shelf. Another point mentioned in reply to a question was that most of the marine production of 2.5 to 2.8 mill mt was coming from 50 m depth zone. She told a questioner that the Fishing Policy-making group in Government of India was dependent on State Governments and stake holders for feedback of exploited fisheries. Sea ranching of shrimp was possible as there were hatcheries to provide seed for the purpose. Hatchery systems for lobsters and crabs would need to be developed and work in this context was in progress. She expressed herself against uncontrolled exploitation of wild shrimp brooders for supply to hatcheries but said that, apart from there being no other alternative at

present, the system was helping in culture shrimp production. She said that implementation of ranching programme was difficult but suggested that the hatchery-owners could be asked to cooperate to the extent of releasing 10% of PLs produced at the hatcheries. Answering another question, she said that any subsidies related to brackishwater farming could be made available through MPEDA. It was pointed out by one of the participants that *Karikadi* catches had been declining of late along Kerala Coast. In this situation, he wanted to know whether fishing for tuna could be taken up as an alternative with government's help. The reply was that occurence of tuna in the coastal zone was sparse and one had to go beyond this zone for viable operations. Clarifying the perceptions on the Aquaculture Bill by the State Governments, she said that, while Kerala and Tamilnadu felt at one stage that the Bill was detrimental, A.P Government had all along felt that it would be beneficial. The Bill was introduced and was now before a select committee. The committee sought views from various bodies. MPEDA strongly supported the Bill. The latest position was all coastal governments supported the Bill. Reacting to a point raised that coastal fishermen were affected because of the farms she said that there had to be a better understanding between fishermen and fish farmers.

Mr. Elias Sait was critical of the unjustified delay in formulating a policy for the exploitation of tuna resources of Indian EEZ. He was also critical of a uniform conservation policy in the territorial waters to be implemented by the Coastal States. This would have to be the function of the Centre as it called for coordination. It was a voluntary system in A.P and an imposed one in Kerala. Fisheries of zones like Pulicat lake were not protected. Joint Secretary agreed that the enforcement of a uniform conservation period had its problems but centre introduced a scheme to provide patrol boats to the coastal states for enforcement of the regulations. Another question asked by Sait was: whether fish could be transacted during the ban period. Reacting, the Joint Secratery said that there was provision for granting off-season allowance by the government concerned and the centre was implementing a scheme for providing Rs. 400/- per month / fisherman as off season allowance, provided there was matching contribution. The response was not however good, she added. In reply to a point raised, she clarified that the expression 'Man' included 'Woman' too. It was mentioned that the Centre was processing a scheme for ameleorating the lot of fishermen. It was referred to State Governments but there was positive response only from three states. There was provision of Rs. 22 crores under the scheme, she said.

J.V.H.Dixitulu, Editor and Publisher, Fishing Chimes, presented a paper on Emerging Fishing Opportunities in Indian EEZ. Pointing out that an estimated 873,000 t of pelagic resources were available in the zone beyond continenetal shelf and another 246,000 t, mostly pelagic, in the Oceanic Zone of the Indian EEZ, and that tuna was a predominant part of these resources, he suggested that the existing trawling fleet of 23-28 m OAL may be equipped for monofilament longlining as well, for minimising investments, as new tuna vessels were expensive. It was also suggested that the possibilities of adding on monofil longlining system to the mechanised fishing fleet of 9 - 16 m OAL could be studied through a pilot scheme in the first instance. He suggested the setting up of a base with needed infrastructure in Great Nicobar Island to facilitate operations of vessels to be engaged in tuna fishing and export of tuna of Sashimi grade to Japan. He suggested the setting up of similar bases, particularly on the North-West. Another suggestion made was to set up a Fishing Vessel Acquisition and Operation Fund in the Union Department of Animal Husbandry and Dairying for extending financial assistance to fishing enterprises for the acquisition and operation of fishing vessels or for upgrading existing vessels.

V.S. Somvanshi presented a paper on the Fishery Resources of Indian EEZ as revealed by surveys conducted by FSI. He said that there were good resources of deepsea shrimp and lobster at a depth of 250 m and beyond off south-west over Quilon Bank, Wadge Bank, Gulf of Mannar and off Karnataka Coast. Some of the trawlers meant for shrimp trawling successfully exploited the resources through stern trawling upto 500 m depth. Resources of *Aristeus* spp were located recently at a depth of 180 m. No doubt there were rich tuna resources in Indian EEZ but there were other viable resources too. Speaking on the closed season, he said that this season, by and large, coincided with the breeding season of majority of marine animals. The need was to popularise new technologies to enable the operators to optimise profits based on sustainable fishing.

Somvanshi said that an exclusive satellite was launched by India recently. This satellite had been sending pictures regularly showing chlorophyll concentrations by colour. This was now enabling prediction of potential fishery zones very clearly.

The Director-General said that the Indian EEZ had rich tuna resources, dominated by tuna, a fish providing the best raw material for sashimi, which had market world over. Rich yellowfin stocks gave the opportunity for India to opt for tuna fishing. Surprisingly, the present potential in the EEZ was the same ten years before, but the reason however varied. It was pointed by him 1/3 of the total potential, mostly of tuna, remained untapped and this had to exploited in a sustainable manner.

The Director-General said that, in this decade, fishing concentration would have to be extended in a significant measure for sustainable exploitation of the resources off Island Zones (Andamans and Lakshadweep). Viable sources of fish and other economically import species were available in abundance in the EEZ and future was with us, he said. He also mentioned that FSI had a website and information could be taken from the website and linkages between various websites.

Business Session III

Mr. D.P.Sarada, Executive Director, Reserve Bank of India, chaired this Session. Mr. C. Radhakrishnan, General Manager, State Bank of India, Mumbai, Prof. Hrishikesh Bhattacharya of Indian Institute of Management, Kolkata, Mr. Annapiah, General Manager, Canara Bank, Mr. M.M. Lateef, General Manager, State Bank of India, Hyderabad, and Mr.

Elias Sait, President, Seafood Exporters Association of India were on the dais. They spoke on various issues connected with financing of fishing industry. The Bankers assured the industry that they were in the business of lending and they would continue to extend the facility to the fishery industries, subject to norms laid down and as applicable.

C.Radha Krishnan and Hrishikesh Bhattacharya spoke on the steps under way for strengthening of the equity base of the companies and said that it was proposed to set up a Reconstruction/Rehabilitation Fund for strengthening the equity of companies on a long term basis. The fund would help the industry and Banks, and this would not be a loan adjustment scheme. Some more information on proposed Reconstruction/Rehabilitation Fund was called for by the Ministry and the query was being analysed. There were positive signals concerning approval of the proposal for setting up the Fund and this could be expected to materialise soon.

Business Session IV

This Session, devoted to value addition was presided over by Mr. E.K. Bharat Bhushan, Joint Secretary, Ministry of Commerce and Industries.

Mr. M. Shimomura, Executive Managing Director of JMPIA, Japan, spoke on Japanese market for value-added shrimp and cephalopods. He made the following suggestions : 1) Process the products immediately after capture; 2) Freeze the products in smaller blocks to facilitate sub-division; and 3) take care of the quality of raw material from the time of catch, avoiding foreign matter scrupulously.

Dr. Shashi Sareen, Director of EIA, made a presentation on WTO and quality certification. Prefacing that WTO was established in 1995 with the objective of dismantling barriers in respect of free flow of trade and to create a global market with equal access to all countries, she said that non-tariff agreements were entered into in respect of sanitary and phytosecurity, and technical barriers to trade and in respect of pre-shipment inspection. The broad concepts of the agreements were a) adherence to interaction standard system of trading partnership, b) mutual recognition based on certificates issued and based on accreditation mechanism, and c) the holding of a certificate was meant to gain access to world markets.

Elaborating on sanitary and phytosanitary agreement, it was pointed out that it allowed the countries to set their own standards for safety. It allowed countries to adopt different inspection methods. Provision for third party certification was meant to assure that the product met the requirements of the importing country. She also explained the role of EIC in certification. A three - tier monitoring system consisting of periodical checks, supervisory visits and corporate aids was introduced. She concluded by saying that 103 units were approved for exports to EU and 211 units for exports to non-EU countries.

Dr. Subasinghe, Project Director, INFOFISH, presented a paper in which he gave details of potential products for India and possible products for introduction immediately, prospects and strategies and the various ways of utilisation of low value fish in terms of products, price and markets. While products of Croakers, Parrot fish, Tilapia, Marine Catfish had a market in USA, market existed in Japan for Tongue-sole and Sillago in Japan. He further mentioned that there was market in South-East Asia for threadfin bream and Indian mackerel, for Eels and Anchovy in U.K, for sharks in Australia, for Silver croaker in China, Taiwan and Korea and so on.

By far the best presentation made was by Howard M. Johnson of Howard M. Johnson Associates of USA on Value-added seafood products in the United States : Trends and Prospects'. He reviewed the key industry trends affecting the US seafood market and discussed value-added seafood trends in the US seafood market and endeavoured to indicate India's position. The present trends in US were a) wild catch was declining, b) imports were increasing and c) aquaculture was playing more important role. In the matter of exports to USA, Catfish, Salmon, and Tilapia were winners. Shrimp was the leading imported item at US $ 3.1 billion, and importers of value-added products (fillets and cooked and smoked) were on the increase. India's seafood exports to US in 1999 were 38,000 t valued at US $ 199 million with a share of 2.2% of overall imports of seafood products into USA. Per capita consumption of seafood in USA was 6.94 kg, he added.

Dwelling on US seafood market opportunities for value-added products, Johnson told the participants that the definition of value-added food was prone to changes from time to time and that it meant different things to different people. In fact, it included further-processed and better packaged products. It was explained that PUD and P&D shrimp, cooked shrimp, squid rings and fish fillets were the traditional value-added products in USA. Besides these, US seafood market opportunities existed for certain new value-added products, such as a) Heat and eat products, b) Flavoured products, c) Products with good profit margins, d) Labour saving products for retail and food service and for e) certain unique items available in limited quantity.

Johnson imparted information on a few ideas on value-addition for availing of US seafood market opportunities. These were a) shrimp curry b) Tandoori Shrimp, c) Malabar crab, and d) Shrimp / crab cakes. India's advantages in encashing on US value-added market opportunities were a) Abundant resources, b) Product variety, c) 'Exotic image' and d) Low labour costs.

In conclusion, he exhorted Indian exporters of marine products to 'Become a Big Fish in the US Market and pursue value-added US Market'.

Mr. Allen Townsend of Anchor Seafoods, UK, made a presentation on marketing of value-added products in UK. He said that there was little provision to ensure sustainability of Indian products in UK market. The present approach was product-led and not market led. He advised Indian marine product exporters to research their product's ability to enter into value-added market and understand it well. He advised that the product should be aimed at a target and

not to prejudge value-addition. Saying that what the customer considered as value-addition alone would fetch a better price, he suggested various quick-fix products such as PTO/CTO, Cooked, Skewers, Sushi prawn, Coated surimi etc. He advised that flavours should not be changed frequently. He wanted the exporters to desist from too much of value-addition and bear in mind that each market had its specific demands. He spoke on the virtues and advantages of branding the products, giving quality markings, and environment codes. The addition of the term 'Organic' or 'From Sustainable fisheries' to indicate the system under which the raw material was produced would add value. He wanted the exporters to adop a common standard management and said that nothing would add greater value than quality. There should be clear specifications and work instructions. In conclusion, he advised : Understand your market.

Mr. Mohan Kumar, National Expert, UNIDO, and former Director, MPEDA spoke on marketing of value - added products. Pointing out that the share of value-added products from India was 9.7% in 1999-2000, consisting of shrimps (30.3%), cephalopods (34.5%), fish paste including surimi (19.6%), crab (5.3%), and others 11.3%, he gave further details of percentages and quantities of products details under each of the categories. He said that 4888 mt of cooked shrimps were exported from India in 1999-2000. Compared with quantity and value of others, cooked shrimp quantity and value was low and its average unit value was US $ 4/Kg.

Japan imported in 1999 value-added products of 26,884 t, of which India's share was 1.7%. He gave details of imports of value-added products from various countries and generally the Indian share of the imports was on the lower side.

Value-addition : India's strengths and Weaknesses : Referring to strengths in respect of value-added exports of shrimps from India, he said these were a) easy availability of raw materials, especially cultured shrimp, and b) availability of processing facilities of international standards. He listed the weaknesses as 1) Small sized shrimp proportion higher 2) Making efforts to earn profits through minimum value-addition 3) Incremental benefits not commensurate with increasing cost, 4) Inability to develop proper marketing tie-ups, 5) Absence of joint ventures, 6) Slow technological change, 7) Failure to standardise quality of cooked shrimp through in - house R & D effort, 8) Poor packaging, 9) Inability to provide consistent supplies to buyers as per specifications, 10) Absence of proper brand equity, and 11) Lack of marketing strategy to differentiate Indian products.

Opportunities and Threats : Mohan Kumar highlighted certain opportunities such as i) expanding market for value-added products ii) Increasing role of super markets in food retailing, iii) Direct sourcing by super markets, and iv) Emerging markets in SE Asia and Far East.

Indian exports were now exposed to certain threats such as competition from Vietnam, organised resistence from processors in buyer countries and eco-friendly packaging requirements.

He also spoke on factors inhibiting value-addition. These were : a) Freight disadvantage, b) Additional labour cost, c) Cooking losses in the case of shrimp, d) Extra packaging cost and e) Increased earnings not commensurate with investment.

Suggestions on Strategies : Strategies to be adopted for marketing value-added products were also suggested by him. These were : a) Target super markets aggressively; b) Trade delegations may be fielded to negotiate for direct tie-up, c) Organising market stands in leading markets, d) Aggressive promotion of Indian brand names through an organised campaign, e) A promotional logo may be developed and put up in selected markets, f) Financial assistance may be availed of from Brand Equity Fund of Government of India, g) More aggressive marketing measures in Japan may be taken up, h) Brand acquisition by exporters may be encouraged and finance for this be obtained at low interest from Exim Bank, i) Packaging may be upgraded, j) Warehousing facilities in buyer countries may be set up with help from MPEDA by SEAI, k) FEMA may be amended to facilitate exemption of value-added products from cess, l) Promotion of R & D to minimise cooking losses in the case of shrimp, m) A campaign to promote value-addition to black tiger may be launched and n) A low intereest scheme for the upgradation of seafood units for the production of value-added products may be introduced.

EXHIBITION

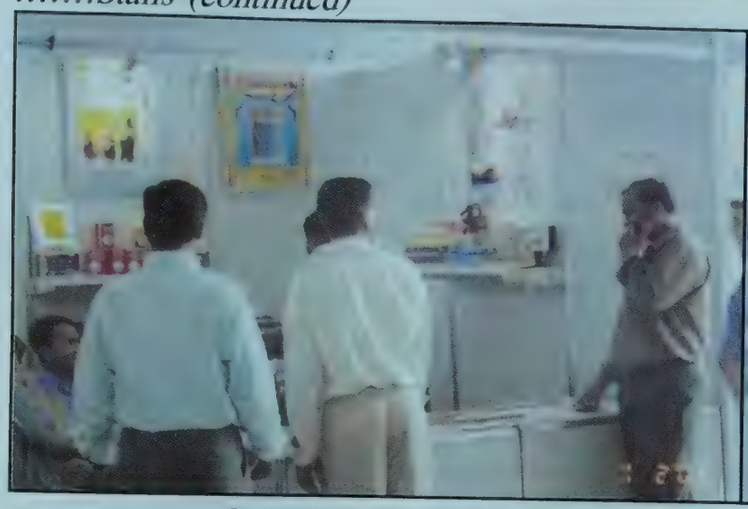
The Exhibition, the main part of the show, was inaugurated by the Union Minister of Rural Development, Mr. M. Rangayya Naidu on 9 Feb 2001 immediately after the inaugural session. He visited most of the stalls. At the stall of the Association of Indian Fishery Industries, he released the special issue of ***Fishing Chimes*** (Jan/Feb 2001) brought out for the occasion.

There were altogether 142 stalls representing exporters, aquafarmers, hatchery sector, various Associations, manufacturers of various requisites, such as feed and several others.

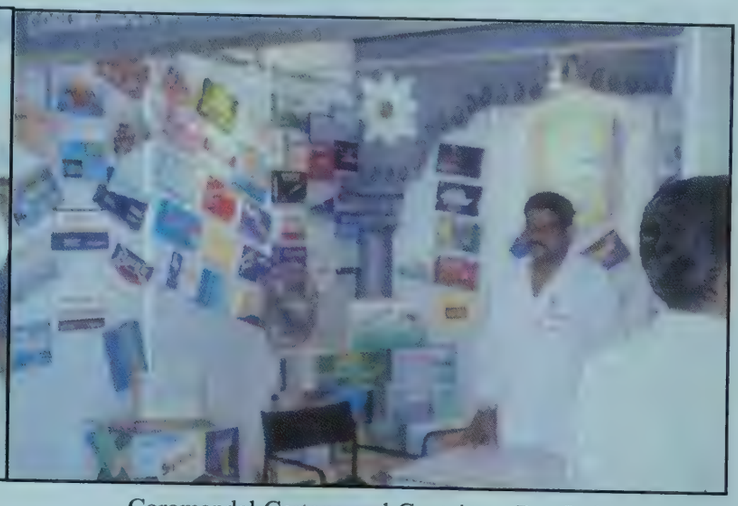
The show came to a close on 11 February 2001 after an eminently successful visitor-pulling run on all the three days. This was due to the dedicated support extended to MPEDA by the Seafood Exporters Association and its regional offices, the Association of Indian Fishery Industries, Shrimp Hatcheries Association, Farmer's Assocation and several others. Those whose prominent movement around to ensure clock-like conduct as noticed were Mr.Joy Ipe Kurien, Mr. B. Ranjit Bhattacharya, Mr. Y. Surya Rao, Mr. V. Padmanabham, Mr. T. Raghunatha Reddy, Mr. M.V. Krishna Rao, Mr. M. Sudarsan Swamy, Mr. Kishore Kumar, Mr. Srinivasa Rao and several others. All the officials of MPEDA, particularly those of the Regional office at Visakhapatnam, played a major part in ensuring the success of the show. There was an all round appreciation of the Show and of the catering arrangements.

The show brought together the leading captains of the industry and it was a great occasion for them to explore business opportunities, strike deals. There were around 900 delegates of whom nearly ninety were representatives of foreign companies. The show projected the strides made by India in capture and cul-

.....Stalls (continued)



Geekay Hatcheries Pvt. Ltd

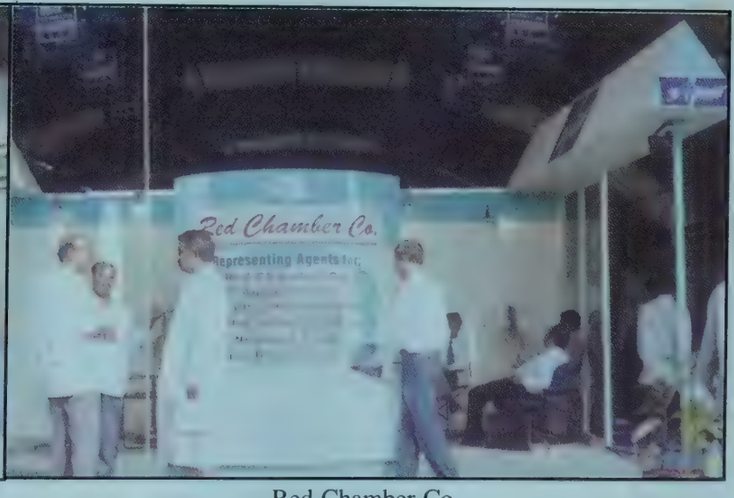


Coromandel Cartons and Containers Pvt. Ltd

B.M.R Hatchery

Nurture Technologies Consultants P. Ltd.,

Saeplast, Mansa, Gujarat
Tel: 079-6751562; Fax: 079-6751561
E-mail: Saeplast@wilnetonline.com



Red Chamber Co.
Tel: 044 6282235/6281085; Fax: 044-6282238
E-mail: maai@satyam.net.in

ture fishery sectors, and the processing and export sectors. The deliberations at the Business sessions had provided lot of information and points to ponder upon to the policy makers to facilitate future policy formulation and formulation of Tenth Plan projects rlating to marine fisheries. Farmers could lear new aspects of diversified culture systems and on breeding of fishes such as Groupers. The manufacturers of various machinaries and equipments could attract the attention of the target groups. Input suppliers to the farming and hatchery-owning enterprises were afforded and excellent opportunity to meet their customers transact business deals and strengthen relationships. This was one of the rare shows where practically no inconvenience of any kind was voiced and this has reflected the smoothly efficient manner the Show was organised and conducted.

Breakthrough in Seed Production of Ganga River Prawn *Macrobrachium gangeticum* (Bate, 1868) : A milestone in Aquafarming.

D.R. Kanaujia, A.N. Mohanty and Shalini Soni
Central Institute of Freshwater Aquaculture
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Bate (1868), while establishing the genus *Macrobrachium*, identified five species under the genus. These are : *Macrobrachium americanus*, *Macrobrachium formosense*, *Macrobrachium gangeticum*, *Macrobrachium logidigitum*, and *Macrobrachium africanum*. Of all these species, information on *Macrobrachium gangeticum* was very meagre with only a six line remark of Bate (1868) "This species was closely resembled to *Macrobrachium formosense*, as identified by Late Colonial Hamilton Smith with the species collected by his friend at Patna, about 250 miles away from Calcutta, where it was used as food and was popularly known in Hindustanee under the name of 'Chingra'. Its body length was about 6 inches and bluish in colour". Thereafter the growth potentialities of this species had not come into light for about 80 years. Tiwari (1949) had reported the description of *Palaemon choprai* available in river Ganga around Banaras (Varanasi). He reported the availability of this species in Patna (Bihar) and also in river Brahmaputra in Assam. The maximum size reported by him was between 164 - 188.5 mm in males and 150 mm in females. This was found to be closely related to the reports of Bate.

Hatchery for Indian River Prawn at CIFA, Bhubaneswar

Inside view of part of the river prawn hatchery.

River prawn at the hatchery, grown out of seed raised thereat

Thirty years later after Bate's (1868) finding, Schenkel (1902) described *Macrobrachium gangeticum* as a new taxon, *Palaemon spinipes birmanicus* and considered *Palaemon spinipes* as the latest synonym of *Macrobrachium rosenbergii* (De Man, 1879). During same time, Schenkel also described the new subspecies *Palaemon spinipes birmanicus* as a different species from *Macrobrachium rosenbergii* and opined

that it is identical with *Macrobrachium choprai* and *Macrobrachium gangeticum*. But Tiwari, (1949) named it as a new species *Palaemon choprai*. One year later, Holthius (1950) erroneously considered *Macrobrachium gangeticum* to be a nomenudum and synonymized *Palaemon spinipes birmanicus* with *Macrobrachium malcolmsonii*. By that time Tiwari still used the generic name *Palaemon* instead of *Macrobrachium*. Johnson (1973) synonymized both *Palaemon birmanicus* and *Palaemon choprai* with *Macrobrachium malcolmsonii* (Edwards, 1844). He treated *Palaemon choprai* as subspecies of *Macrobrachium malcolmsonii* and gave the status of *Palaemon spinipes birmanicus* to it rather doubtfully. Holthius (1980; 1988, 1989, 1999) treated *Macrobrachium choprai, Macrobrachium birmanicus* and *Macrobrachium malcolmsonii* as three different species.

Tiwari (1955), based on recent investigations, made it clear and gave the final conclusion that *Macrobrachium gangeticum* is the third largest freshwater prawn of middle and upper stretches of Ganga river system, corroborating the views of Bate (1868), that this is the synonym of *Palaemon spinipes birmanicus* Schenkel (1902) and *Palaemon choprai* (Tiwari, 1949). This conclusion of Tiwari has now been proved by the larval development studies carried out by Kanaujia *et al.*, at Central Institute of Freshwater Aquaculture, Kausalyaganga, Bhubaneswar that *Palaemon choprai* (Tiwari) or *M. gangeticum* (Bate) are synonymous and are species different from *Macrobrachium malcolmsonii*.

With imposition of restrictions on aquaculture activities in Coastal Regulatory Zone (CRZ), freshwater prawn farming has been gaining in importance. In this context, *M. gangeticum* (Bate, 1868) a compatible freshwater prawn with high economic value, appears to be a highly suitable candidate for culture. This species has been reported from the river Ganga and its tributaries in Eastern Uttar Pradesh, Bihar and river Brahmaputra in Assam (Tiwari 1950). In India, the species is found abundantly in the upper and middle stretches of Ganga and recorded in Kanpur, Allahabad, Mirzapur, Banaras, Ghajipur, Buxar, Arrah, Patna, Mungar, Bhagalpur, Sahibgunj, Farrakha, Lalgola, (Jhingran, 1956: Kanaujia, ms). The size and weight of the species, reported so far ranged from 200-250 mm and 50-100 g in male and 150-200 mm and 35-75 g in female. It contributes over 50% of total prawn catch of the middle stretch of the Ganga river system. Recent experimental trials made by Kanaujia *et al.*, at CIFA revealed that the larval development of *M. gangeticum* takes 22-45 days to attain post-larval stage, whereas *M. rosenbergii* and *M. malcolmsonii* take 30-50 days and 40-60 days respectively. Natural breeding of this species in the Ganga river system and in pond conditions has been reported to take place from May to October.

Breakthrough in larval rearing and post-larval production of Gangetic prawn *Macrobrachium birmanicum choprai*

Successful completion of all eleven larval stages and post-larval production of the Ganga River prawn *Macrobrachium birmanicum choprai* have been achieved for the first time at the Freshwater Prawn Culture Unit of Central Institute of Freshwater Aquaculture. This is a major breakthrough for developing a commercially viable hatchery technology for large scale seed production of yet another large variety a *Macrobrachium* species. Adult male and female prawns, collected from the river Padma at Lalgola, Murshidabad District of West Bengal, were transported by road through oxygen packing during February, 2000. The prawns were reared in a 1000 lit FRP tank under yard conditions and fed with egg custard and mussel meat *ad libitum*. Water quality was monitored through water exchange and providing aeration. The pre-mating moult and spawning first occurred on 17 June 2000. The berried female was then reared under laboratory conditions in 300 lit plastic pool filled with 150 lit of brackishwater of 5% salinity. On day 12, first stage zoeae hatched out. The spent female was then removed from the tank and salinity of the medium was increased gradually from 5 to 16%. Air-lift biofilter recirculatory system was employed during larval rearing. The larvae were fed initially with freshly hatched Artemia nauplii and thereafter, supplemented with egg custard and mussel meat. The water temperature ranged from 29 to 31°C. The first post-larva appeared on the 22nd day after hatching. As many as 16 to 18 moults were observed during the completion of eleven larval stages and post-larvae, which seem to be similar to *M. malcolmsonii* but with different characteristic features. First few post-larvae were observed by 22nd day and as many as 2928 post-larvae were produced in 300 lit tanks in 50 days of rearing. Further trials using berried females collected from the river Ganga around Farakka and Patna during August 2000 also revealed similar trend in larval growth and post-larval production besides general behaviour. The data of the trials suggest that a range of 16 to 18% salinity in the medium is most suitable during larval growth and post-larval production in *M. birmanicum choprai*. With considerable shorter period in larval cycle of 22 to 50 days compared to *M. rosenbergii* (30-50 days) and *M. malcolmsonii* (40-60 days), this species could be exploited for commercial ventures in order to increase the freshwater prawn production in the country.

Seed Production and Grow-out Culture of Indian River Prawn *Macrobrachium malcolmsonii* (H.M. Edwards)

Macrobrachium malcolmsonii, the second largest fast growing freshwater prawn recorded with 260 mm size, is widely distributed in Indian rivers and also in rivers of Bangladesh, Burma, Sri Lanka and Pakistan, of the Indian subcontinent. This prawn has taste and consumer demand. Thus, it is considered as a good candidate species for culture. It is most suitable for monoculture and also for polyculture along with Indian major carps and Chinese carps. Culture of the

species may yield 750-1500 kg/ha/yr under monoculture, and 500 kg prawn and 3000 kg/ha/yr of fish under polyculture. Females attain sexual maturity at 60-70 mm size and they breed during April to November in different rearing systems. Fecundity varies from 6000 - 80,000 depending upon the size. After 10-15 days of incubation, hatched zoea larvae require 18-20 ppt brackishwater for larval development. First stage zoea passes through eleven larval stages and takes 40-60 days to metamorphose into post-larvae. Success of any hatchery operation depends on the feed and water quality. Artemia nauplii, mussel meat and egg custard are used as feed for the developing larvae. Maintenance of suitable water quality and adequate nutritious food help in rearing successfully all eleven stages and finally of metamorphosis into post-larval stages within 40-60 days.

The zoea stage I takes 7-10 days to attain stage V. The progressive increase in size during these stages is slower. Stage V takes 10-15 days to reach stage VI. The first post-larvae appear on the 40th day and completion of the process takes about 50 days. A specially designed shell-string is hung into larval-rearing tanks to remove daily newly metamorphosed post lavae to avoid cannibalism and by this process 20 - 30 post-larvae per litre are produced. Since post-larvae are reared in saline water, they are acclimatized in freshwater before taking to the farm for culture. The post-larvae are reared in nursery tanks to grow to 30-50 mm, which requires about 20-30 days. They are fed with suitable supplementary feed having 30-40% protein, with 50% of each animal and plant origin, for obtaining higher growth and survival.

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Mr. K. Gopakumar with President of Iran

Dr. K. Gopakumar, Deputy Director General (Fisheries) ICAR, recipient of 14th Khwarizmi International Award with His Excellency Said Mohamed Khatami, President of the Islamic Republic of Iran who handed over the Award to Dr. Gopakumar on 5 Feb, 2001 in Teheran.

Probiotics

Possible Applications in Aquaculture

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What are Probiotics?

Pro : Favour, Bios: Life. An antonym of antibiotics, probiotics involves multiplying few good/useful microbes to compete with the harmful ones, thus suppressing their growth. These include certain bacteria and yeasts that promote life and are not harmful on continued use for a long time. These have been in use since time immemorial and perfection of the art as science has been in large part, a result of historical use and not based on scientific criteria. According to an old definition, probiotics are organisms and substances which contribute to the sustenance of intestinal microbiota. However, Ruiz *et al.* (1998) defined it as beneficial micoorganisms which can protect organisms against pathogens or enhance their growth. Probiotics are live microorganisms which can protect organisms against pathogens or enhance their growth. Probiotics are live microorganisms supplemented in food or feed which render beneficial effects on the intestinal microbial balance. Fuller (1992) described it more convincingly as 'live microbial feed supplements which beneficially affect the host animal by improving its intestinal microbial balance'.

Gibson and Roberfroid (1995) introduced the concept of 'prebiotics'. It is defined as a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or the activity of one or a limited number of bacteria in the colon, and thus improves host health. It has also been proposed to call 'synbiotic' the combination, in the same food prouct, of a pro-and a prebiotic.

Probiotics in Aquaculture

The most widely studied group among these is the Lactic Acid Bacteria (LAB; e.g., *Lactobacillus* sp.). Others are *Propionibacterium* sp., *Enterococcus* sp., *Bifidobacterium* sp., *Saccharomyces* sp., *etc.*

Jory (1998) defined probiotics from aquaculture point of view as culture (single or mixed) of selected strains of bacteria that are used in culture and production systems (tanks, ponds and others) to modify or manipulate the microbial communities in water and sediment, reduce or eliminate selected pathogenic species of microorganisms, and generally improve growth and survival of the targeted species.

Microbes are very important and have critical roles in aquaculture systems, including shrimp farming at both the hatchery and the growout level, because water quality and disease control are directly related and closely affected by microbial activity. Probiotic protection can be due to different mechanisms such as nutritional competition or production of antibacterial substances. In aquaculture, the current trend is to replace antibiotics by probiotics for ecologicl considerations as well. There are environmental concerns with regard to the use of antibiotics because :

i) Antibiotics-resistant microbial strains develop on continued use of the same,

ii) Trans-ovarial/horizontal transmission of resistant strains have been reported.

iii) There is always a threat of residual toxicity leading to bioaccumulation/biomagnification, and

iv) These are low biodegradable and persist in the environment for longer time.

Because of the importance to limit the occurrence of pathogenic bacteria in the very-susceptible-to-disease-outbreaks, intensive systems are being used to produce shrimp postlarvae in commercial hatcheries around the world. Rao and Sudha (1996) discussed recent biotechnological approaches, viz., bioremediation, probiotics and water recirculation to manage water quality. Mukhopadhyay and Paul (1996) discussed the advantage of probiotics as supplementary components in aquaculture feeds. Important colonization factors are adhesion to components present in the intestinal mucosa and ability of growth in mucus as the sole source of nutrients. The strains isolated from fish showed strong adhesive properties to isolated intestinal mucus as well as growth to a high cell concentration in mucus. Phospholipids have been described to serve as adhesion receptors for *E. coli* and *Helicobacter* sp. Knowledge about such receptors for the LAB as mainly glycoproteins needs to be strengthened.

Improved hygiene and biosecurity, development of probiotics and immunostimulants and improvement of artificial feeds promise better postlarval

fitness while reducing cost of improving reliability of production (Browdy, 1998).

During growth of fish spawn and shrimp/prawn larvae in aquaculture, the first food supplied is usually the rotifer, *Brachionus plicatilis* and algae are commonly included in the system as food for the rotifers, thereby maintaining their nutrient quality. The addition of lactic acid bacteria to rotifers fed to turbot larvae, *Scophthalmus maximus*, was found to improve growth (Gatesoupe, 1991a) and increase resistance against pathogenic vibrios (Gatesoupe, 1994). Nutrients such as nitrate, phosphate and silicate levels are also found to be more in *Penaeus indicus* experimental tanks compared to controls on provision of probiotics (Ravi *et al.*, 1998). The bacterial species composition was different in the pond water upon use of probiotics that demonstrated the possibilities to change bacterial species composition and improve prawn production in large water bodies (Moriarty, 1998). Hence, larval growth enhancement is seen when probiotic cultures are added to larvae (Ruiz *et al.*, 1996).

As fish are poikilothermic, their gut flora is temperature-dependent, i.e., there is an increase in total counts and in the proportion of anaerobic forms with temperature. The state-of-the-art concerning probiotics is not as advanced in fish as it is in homoiothermic vertebrates, and further studies are thus required in this field to promote the environment-friendly development of fish culture.

Gatesoupe (1991b) proposed an alternative by feeding the rotifers affected by *Vibrio* with probiotics, i.e., food additives containing live lactic bacteria or *Bacillus* spores and recorded most promising results, which decreased the amount of Vibrionaceae in the rotifers and improved the survival rate of turbot (*Scophthalmus maximus*). The uptake of probiotics by rotifers may increase the resistance of fish larvae to pathogens. They also reported that, although the feeding of probiotics did not improve the survival rate of turbot, their mean weight increased indicating the role of some growth factor from the probiotics.

Lactic Acid Bacteria in Fish

It has also been reported that some lactic acid bacteria isolated from the gastrointestinal tract of fish can act as probiotics against various fish pathogens. These candidates are able to colonise the gut, and act antagonistic against Gram-negative fish pathogens. These harmless antibacterial substance-producing strains may reduce the need to use antibiotics in future aquaculture.

Reports on the presence of lactic acid bacteria in the intestinal microbiota of fish (Schroder *et al.*, 1980; Strom, 1988), suggest that there exist lactic acid bacteria that constitute non-pathogenic members of the indigenous intestinal microflora of healthy fish. Some lactic acid bacteria isolated from the GI tract of fish had inhibitory effect against bacterial fish pathogens. Pilet *et al.* (1995) isolated *Carnobacterium piscicola* and *C. divergens* that produced bacteriocins active against *Listeria monocytogenes*. The former produced piscicocin V1 and the latter, diversin V41. LAB bacteriocins have been reported to inhibit *Clostidium botulinum* spores (Okerere and Montville, 1991).

Dry feed containing lactic acid bacteria (*Carnobacterium divergens*) isolated from Atlantic cod (*Gadus morhua*) intestines improved disease resistance of cod fry exposed to a virulent strain of *Vibrio anguillarum* (Gildberg *et al.*, 1997).

Some of the bottlenecks in ensuring long-term benefit of probiotic-feeding are, competition for attachment site, i.e., colonisation, and antagonism shown by these organisms in terms of reduction in pH, production of secondary metabolites, and production of bacteriocins *etc.*

Some lactic acid bacteria are pathogenic to fish (Cone, 1982). Pathogenic lactic acid bacteria such as *Streptococcus*, *Enterococcus*, *Leuconostoc*, *Lactobacillus*, *Lactococcus*, and *Carnobacterium* belong to be normal microbiota of the gastrointestinal tract in healthy fish and have been detected from ascites, kidney, liver, heart and spleen (Ringoe and Gatesoupe, 1998). However, it is well known that the population level of lactic acid bacteria associated with the digestive tract is affected by nutritional and environmental factors like dietary polyunsaturated fatty acids, chromic oxide, stress and salinity.

The effect of gut flora on digestion in cold water fish is probably negligible, as a minimum level of 10^7 CFUs/g of intestinal content seems necessary for significant bacterial enzyme activity (Gatesoupe and Lesel, 1998).

Why Probiotic-feeding?

Beneficial role of probiotics in general includes their use in the treatment of various types of diarrhoea, the alleviation of GI side-effects of antibiotic treatment, the alleviation of lactose intolerance, the relief of constipation, and the general balancing and stabilisation of intestinal integrity. More recent, claims for some strains include immuno-modulatory and vaccine-adjuvant effects as well as cholesterolemic and anti-carcinogenic ability.

Once colonised in the GI tract, probiotics can affect the flora in three ways :

a) by providing a preformed metabolite,

b) by continuous provision of viable cells which do not colonise but which survive and metabolise *in situ*, and

c) by providing viable cells which colonise the gut and produce useful metabolites *in situ*.

Recent trends in Probiotic Research in Aquaculture

Probiotics have been tried in culture of larval food organisms and shrimp larvae. Some of the good/beneficial microbes, e.g., non-pathogenic isolates of *Vibrio alginolyticus* etc. can be inoculated into shrimp culture with an aim to suppress the pathogenic vibrios, such as, *Vibrio harveyi*, *V. parahaemolyticus*, *V. splendens* etc., thereby reducing the problem of opportunistic invasion by these bacteria, in shrimp. Andlid *et al.* (1994) reintroduced and successfully colonised the isolated yeasts in fish intestine in a high number, without visible

negative effects on the fish.

A non-virulent *Carnobacterium* sp. isolated from the GI tract of Atlantic salmon, *Salmo salar*, produced inhibitory substances against bacterial fish pathogens. Production of growth inhibitors *in vitro*, in mucus and faecal extracts, against *Vibrio anguillarum* and *Aeromonas salmonicida* was demonstrated (Joborn *et al.*, 1997).

Few multinational pharmaceutical companies have introduced into the market commercial preparations as probiotic feed/food supplement in various commercial names as 'Aqualact' and 'Spilac'.

Functionality of Probiotics

Functionality of probiotics necessitates species compatibility. This is established by observing the ability to survive transit through the GI tract, adherence to the intestinal epithelial cell lining, production of antimicrobial substances towards pathogens, ability to stabilise the intestinal microflora, antigenotoxic properties, a short generation time, a good shelflife in food or powdered preparations and non-pathogenic properties. Yoghurt protects against diarrhoea, constipation, heart disease, colon cancer and lactase deficiency as well as providing effective therapy for sunburn and vaginal thrush, all this attributable to the LAB, which are the most common probiotic organisms in use. The table below lists the desirable properties of probiotic lactic acid bacteria with special reference to human beings :

Growth promotion

Tissier (1905) first described the presence of bifidobacteria in breast-fed milk and babies that might be helping as a probiotic for better growth and development. Later, its predominant presence in human milk was attributed to N-acetylglucosamine.

LAB are responsible for fermentation in gastro-intestinal (GI) tract. They act on complex carbohydrates like starch and cellulose and split them into simpler compounds for absorption beside synthesising many vitamins of B complex group and vitamin K in the GI tract. Some probiotics have been observed to increase appetite and good health. An overall increase in weight gain presumably results from infection control and from increased digestibility of nutrients (Goldin, 1998). Dietary additions of *Bifidobacterium globosum A* tended to increase the growth rate and feed intake on weaning pigs, but feed efficiency, prevalence of scouring, and pH and chloride ion concentration of gastrointestinal contents were not affected (Apgar *et al.*, 1993).

Probiotic strain characteristics	Functional and technological properties
• Human origin	Species-dependent health effects and maintained viability; applicability to fermented foods
• Acid and bile stability	Survival in the intestine
• Adherence to human intestinal cells	Competitive exclusion of pathogens : immune modulation
• Colonisation of the human intestinal tract	Multiplication in the intestinal tract at least temporarily, immune modulation
• Production of antimicrobial substances	Pathogen inactivation in the intestine, normalisation of gut flora
• Antagonism against carcinogenic and pathogenic bacteria	Prevention of dental decay, prevention of pathogen adhesion
• Safety in food and cllinical use	Accurate genus, species and strain identification documented safety
• Clinically validated and documented health effects	Dose-response data for minimum effective dosage in different products
• Shelf life and stability during processing and storage	All the above properties should be maintained during processing & storage, especially adherence, anti-microbial activity, anti-carcinogenic properties.

Immunostimulation/ Immunomodulation

Probiotic bacteria offer new dietary alternatives for immunotherapy to counteract local immunological dysfunctions and to stabilise the natural gut mucosal barrier mechanisms. LAB administered orally stimulated the immune system in the non-specific way (Fuller, 1992). Isolauri *et al.*, (1995) tested *Lactobacillus* sp. as an adjuvant to an oral vaccine to rotavirus in children. *Lactobacillus casei* YIT 9018 (BPL) preparations have been shown to act as immunomodulators altering anti-tumor responses.

Anticarcinogenic potential

Diets rich in animal proteins and fat increase susceptibility to colon cancer (Armstrong and Doll, 1975), apparently through increased conversion of procarcinogens to carcinogens by the intestinal microflora. Probiotics, if taken in a regular basis, may lower the incidence of colon tumors (Goldin, 1998). However, this requires further confirmation. Epidemiological studies have indicated that consumption of high levels of cultured dairy products may reduce the risk of cancer (Reddy *et al.*, 1983). Centrifugal separation of yogurt into solids and supernatant fluid fractions revealed that the anti-tumor activity was localised in the solids fraction.

The following mechanisms are indicated in various studies relating probiotics (lactic acid bacteria) intake and cancer:

1. Alternation in intestinal micro-ecology (microflora)
2. Altered intestinal metabolic activity
3. Normalised intestinal permeability
4. Enhanced intestinal immunity (immune response)
5. Strengthened intestinal barrier mechanisms

Disease Control through Probiotics

In aquaculture, disease problems necessitate the use of bacteria as probiotics an alternative to antibiotics. Gibson *et al.*,(1998) introduced BLIS (bacteriocin like inhibitory substance) producing *Aeromonas* media, strain A199, to act as a probiotic which exhibited antagonistic activity against a wide range of fish/ shellfish pathogens *in vitro*. Rengpipat *et al.*, (1998) added *Bacillus* S11 bacterium isolated from black tiger shrimp habitats to shrimp feed as a probiotic in three forms: fresh cells, fresh cells in normal saline solution, and in a lyophilized form. After challenging shrimps with a shrimp pathogen, *Vibrio harveyi*, by immersiion for 10 days, all probiotic treatment groups had 100% survival, whereas the control group had only 26% survival. Moriaty (1998) observed luminescent *Vibrio* disease, killing prawns before 80 days of culture was reached and in contrast, a farm using the probiotics was culturing prawns for over 160 days without problems, by using *Bacillus* at abundances of about 1 x 10^4-10^5/ml.

A commercial bacterial inoculum cultured on site called Biostart™ was applied to three channel catfish *Ictalurus punctatus* ponds at Auburn, Alabama, USA, three times per week from May until October 1996 and survival and net production of fish was significantly ($P \leq 0.1$) greater in ponds that received the bacterial inoculum than in controls (Queiroz and Boyd, 1988). There is a dominance shift from Aeromonas to Vibrio when fish migrate from freshwater to the sea.

Munro *et al.*, (1995) isolated four bacteria, identified as a *Flavobacterium*, *Vibrio fluvialis, Vibrio natrigens* and *Vibrio* sp. and all were strongly inhibitory to pathogenic bactria. *Flavobacterium* inhibited growth of *Pavlova lutheri* from an inoculum of 10^3 CFUs/ml. Inhibition was due to a heat-labile factor released by the *Flavobacterium* into the culture medium, bacteriocin(s) which inhibited the growth of a range of vibrios.

Taiwanese scientists are using probiotics in feeds and ponds, working with recirculating ponds, experientng with vaccines-and concentrating on good pond management. As these ideas spread to the farms, Taiwan's production of farm-raised shrimp would show a steady increase.

TABLE : Bacteriocin Classes produced by lactic acid bacteria

Class	*Subclass*	*Description*
Class I		Lantibiotics
Class II		Small (<10 kDa), moderate (100°C) to high (121°C) heat-stable, non-lanthionine-containing membrane active peptides.
	IIa	Listeria-active peptides with -Y-G-N-G-V-X-C- near the amino terminus
	IIb	Two-peptide bacteriocins
	IIc	Thiol-activated peptides
ClassIII		Large (>30 kDa) heat-labile proteins
ClassIV		Complex bacteriocins: protein with lipid and/or carbohydrate.

Modified after Ner et al (1996)

Pathogen exclusion from gut

Some probiotics have been seen to produce certain antibiotics like acidolin, acidophylin, lactobacillin and lactocidin (bacteriocins by bacteria, e.g., *Lactobacillus*) effective against many pathogenic bacteria like *Escherichia, Salmonella, Streptococcus, Shigella, Proteus, Klebsiella, Pseudomonads, Bacillus* and *Vibrio*, thus help to fight diseases. Lactobacillus particularly, has been effective by producing certain weak organic acids like lactic and formic acid. However, no report till date exist on bacteriocins *per se* effective against Gram-negative bacteria.

Bacteriocins are a heterogenous group of antimicrobial substances in respect to producing bacteria, antibacterial spectrum, mode of action, and chemical properties (Daeschel, 1989). Bacteriocins are thermostable, sensitive to proteases as a part of the molecule is a peptide and generally have a norrow range of action (Juillard *et al.*, 1987).

LAB have been demonstrated to produce bacteriocins such as, lactocidin, lactobrevin, acidophilin, bulgarican and acidolin etc. These are biologically active low molecular weight proteins, produced by certain species of the genera *Lactobacillus, Lactococcus, Streptococcus* and *Pediococcus* etc. Bacteriocins produced by lactobacilli have been characterised from *Lactobacilus fermentum* (De Klerk and Smit, 1967), *Lactobacillus helveticus* (Upreti and Hinsdill, 1975), *Lactobacillus acidophilus* (Muriana and Kleinhammer, 1987) and *Lactobacillus plantarum* (Daeschel *et al.*, 1986). The two bacteriocins produced by lactococci, nisin and diplococcin, are well characterised.

Adsorption of toxic compounds and relief from physiological discomfiture

Some probiotic bacteria such as, *Lactobacillus bulgarius* are potent toxin neutralisers. Probiotics may downregulate intestinal inflammatin and hypersensitivity reactions in infants with food allergies. Probiotics may be useful in preventing alcohol-induced liver damage.

Antibioses for host benefits

Probiotic bacteria, being aerobes, lower the oxygen tension and render the stomach and intestines less prone to the aerobic pathogens to thrive. They also compete with these pathogens for food and space. Consequently, some of the pathogens are forced to die. There exist evidences that the intestinal microbiota of higher animals contributes to resistance against invading pathogens.

Pedicococcus pentosaceous 43200 appears to be the most promising strain for further research on bacteriocin-mediated protection against *C. botulinum* hazards (Okereke and Montville, 1991).

The efficacy of the chosen probiotic

TABLE : Health Claims of Probiotics in Humans

Intestinal disorder	*Other disorders*	*Other uses*
• *Diarrhoea*	• *Vaginitis*	• *Stabilisation of flora*
• *antibiotic induced*	• *Alcohol-induced liver disease*	• *Recolonisation of bowel after antibiotic treatment*
• *travellers*	• *Cancer*	• *Treatment of food allergies*
• *infantile*	• *Hypercholesteraemia*	• *Adjuvant for vaccines*
• *Constipation*		• *Increased weight gain during development*
• *Colitis*		
• Salmonella & Shigella *infections*		
• *Lactose intolerance*		
• *Flatulence*		

TABLE : Classification of probiotic organisms and their safety status (with relevance to humans)

Organism	Infection potential
Lactobacillus	Only some opportunistic infections
Lactococcus	Mainly nonpathogens
Leuconostoc	Some isolated cases of infection
Streptococcus	Only some opportunistic infections
Enterococcus	Some haemolytic and antibiotic resistant opportunistic pathogens
Bifidobacterium	Some isolated cases of infection
Saccharomyces	Some isolated cases of infection

Donohu and Salminer (1996)

Selection Criteria for Probiotics

General Aspects	**Origin**
	Biosafety
Physiological Aspects	**Activity and viability**
	Resistance to pH, gastric juice, bile and pancreatic juice
Functional & Physiological Aspects	**Adherence to intestinal epithelium/tissue**
	and / or
	Antagonism to pathogens, antimicrobial activity
	and / or
	Stimulation of immune response
	and / or
	Selective stimulation of beneficial microbes and suppression of harmful ones
	and / or
	Beneficial systemic effects

strains can be recognised by methods such as, a) testing strains in field trials (culture identification), b) assessing bacteria *in vitro* for ability to adhere and grow in the gut and for antibacterial activity and c) taking a good coloniser and by genetic manipulation inducing it to produce antibacterial substance(s) or any other such properties.

Safety of Probiotics

This approach can be used to assess the safety of probiotics of a proposed or accepted probiotic strain with studies on 1) intrinsic properties of the strain , 2) pharmacokinetics of the strain and 3) interaction between the strain and the host.

Future Prospects

Probiotics in general and LAB in particular have been, uptil now, performing basically similar tasks, differing only in scale and precision. Study on these organisms is on the verge of quite new applications based on a better understanding of the potential of LAB in biotechnology and especially their role in health and disease.

Today, most probiotic strains are used along with dairy products. Present and future studies indicate that new probiotic functional foods will include infant formulae, baby foods, fermented fruit juices, fermented soy products and cereal-based products without milk and also disease-specific clinical foods containing viable probiotic bacteria. In any case, probiotics more than justify further multidisciplinary research in this field.

Preparing Probiotics for Aquaculture

Generally, the best approach for screening of a potential probiotic is to isolate the microbe from the culture and enhance its natural effects, favouring their growth by adding some nutrients or distributing large quantities of them in the culture. Interesting results have already been obtained, especially in shrimp aquaculture, some of which have been discussed.

After screening a potential probiotic the next challenge likely to be encountered is in regard to a suitable carrier. The application could be done along with feed in pelleted, encapsulated and free concentrated forms. The common problems that may arise thereafter are, application of lactic acid bacteria in fish feed, to reach the gut in sufficient numbers, and the viability of these organisms there for a long period.

When probiotics in any of the above mentioned forms is applied in the fish pond, there is every likelihood that it may undergo dissociation and dispersion, it may lose viability/survivality, or it may even settle at the pond bottom where the basic purpose is lost. A viable answer to such a problem is encapsulation of the

diet. The problem that may further arise out of this is that these free floating encapsulated forms will be available to surface feeders, and column and bottom feeders may be deprived of it.

Another aspect to be borne in mind is that the feed must be pasteurised to avoid any other contaminating organism followed by the addition of the probiotic organism. But then, there is always a risk of post-pasteurisation contamination. And, pre-pasteurisation addition of the LAB probiotics may not be a suitable proposition as these do not tolerate heat treatment.

Further, a suitable addhesive like guargum, carragenan, CMC or any other gelling agent must be used to fix LAB to the fish feed. This could ensure an increased water stability of the composite feed and avoid dispersion/dissociation of the organism.

Conclusion

Different species of *Bacillus* and *Sachharomyces* are in use as probiotics for runinants. Few fungal strains like non-toxigenic *Aspergillus* sp. have also been tried for the same. These probiotics proved to alter the fermentation pattern of rumen, leading to increased VFA production favourable for animal growth and production (Pattnaik *et al.*, 1999). *Sachharomyces cereviceae*, being an aerobe demanding excess oxygen, scrub the limited oxygen available in the rumen, thereby providing absolute anaerobiosis for profound growth of ruminal anaerobe. Fungal species, though they do not colonise rumen, are the common source of some essential hydrolytic enzymes such as cellulases. This might require extraction of the enzyme from the fungal source *in vitro* and utilising it for probiotic activity.

Most probiotics have been designated as 'generally recognised as safe' (GRAS) based on the their long history, though there have been occasional reports of bacteraemia and endocarditis associated with *Lactobacillus*. Probiotics have been successfully used in aquaculture to enhance both internal and external microbial environments. The role of beneficial bacteria to limit and to control environmental pathogens will become particularly important in the future of aquaculture, especially with regard to the increasing number of antibiotic resistant strains of bacteria, the tightening of governmental and environmental regulations of treatments, and the cost-effectiveness.

The role of bacteria in fish culture is important for fish health and also environmental conservation (Gatesoupe and Lesel, 1998). Partnership venture in this regard between Biomar, the Department for Seafood Research of the Danish Institute of Fisheries Research and the Danish Biotechnological Institute with the specific goal of "carrying out research on factors affecting quality of fish and fish products" is on (Anonymous, 1998).

Bacteria antagonistic towards algae would be undesirable in larval rearing and if bacteria are to be selected which are beneficial (probiotics) in larval rearing systems their possible interaction with algae must be considered. The probiotics are likely to release antibiotics, but their deciding advantage over chemicals lies in the fact that they work at a very low concentration (few tens CFUs per rotifer). The mechanism by which the bacterial treatment (probiotics) influence fish survival cannot be explained from data collected. Further initiatives to define the potential benefits of these treatments to aquacultural production and further determining their mechanisms of action in pond ecosystems is essential.

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Stagnating Reservoir Fish Production of India

(A Critical Appraisal with Trends in Tamil Nadu highlighted)

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Reservoir Resources

Reservoir Fisheries offer a "non consumptive use" of water resources. There has been no proper survey of the available area of reservoirs in India. A foreign scientist's (Fernando 1980) estimate of 3 million ha was faithfully accepted (expected to double by 2000 A.D) by the National Commission on Agriculture too. Another foreign scientist estimated our reservoir area to be 2 million ha (Bhukaswan. T 1980). But Srivastava (1984) and Jhingran (1989) recorded that India has 978 reservoirs with a total area of 1.7 million ha. This is nearer the truth. The Government of India (1993) estimated the area of reservoirs to be 2.09 million ha. Tamil Nadu has 52,000 ha of reservoirs.

Fish Yields from Indian Reservoirs : General Account

Reservoirs are expected to provide considerable supply of fish to our population. Against this expectation, the contribution of reservoirs is reported to be 50,000 to 60,000 mt (Pathak 1990), which is about 4-5% of inland fish production. The average yield is reported to be 14.5 kg/ha/year, against a "Potential" of 50 kg/ha and a "sustainable" yield of 100 kg/ha. Small reservoirs are expected to yield 100 kg/ha. Shrivastava (1985) has rightly commented that "database for reservoir systems on production etc., is inadequate". The same comment was made by the NCAER.(1986). While this may be true at All India level, Tamil Nadu provides complete annual details, including species-wise composition. The data base is thorough. This apart, two exhaustive accounts of the Reservoir Fisheries and their limnology in Indian States were presented by Sreenivasan (1991) and Sugunan (1995). They provide a good data base.

Fish Yields from "Major Reservoirs of Tamil Nadu"

Total fish output from Tamil Nadu Reservoirs for the last one decade is provided in Table I.

These results will be discussed elsewhere in this paper. Fish production from a few selected reservoirs of Tamil nadu is presented in Table-II. Mettur Reservoir, the largest in Tamil nadu is not included in the Table since a very exhaustive account of this for the fifty years had been published recently (Sreenivasan 1988, 1989). The fishery of 25 small reservoirs had also been discussed by Sreenivasan (1999).

Production Trends in Tamil Nadu

According to the Information Brochure No.2 of the Directorate of Fisheries, of Tamil Nadu, the total production of fish from all reservoirs of the state in 1984-85 was 1611.871 mt (as 33.65 kg/ha). The split-up is as follows:

Small Reservoirs: 15441 ha; 963.0 mt; 62.37 kg/ha. Revenue Rs. 3.8 million.

Medium Reservoirs: 9653 ha; 130.672 mt 13.55 kg/ha. Revenue Rs. 7.4 lakhs.

Large Reservors: 22805 ha; 1611.871 mt. 33.65 kg/ha and Revenue Rs. 1.35 million

It will be clear from the above particulars that the yield and revenue from small reservoirs was higher compared to medium and large reservoirs. The trends in yield and and revenue are taken from Table I & II. It is evident that the Tamil Nadu Fisheries Development Corporation (TNFDC) consistently performed well year after year. Compared to the departmental management, the production rate (kg/ha) has been higher and the revenue also three times more in TNFDC reservoirs, compared to departmental reservoirs. The main reason for this is that the TNFDC was given the more productve reservoirs. Also, whenever there is loss of revenue or production, the TNFDC abandons such reservoirs to resecure them when production improves. (eg., Palar - Palandalar, Uppar etc.). In 1997-98, the TNFDC operated 11,088 ha of reservoirs, producing 426.73 mt of fish (38.5 kg/ha) earning Rs.8.69 million. The yield is, however, half that of 1994-95.

A distressing feature is the stagnation or fall in total reservoir fish harvest output. In the last 10 years, the yield has been hovering between 1258 to 1960 mt/yr and has never crossed even a modest 2000 mt mark. The average for this decade was 1413.50 mt (27.2 kg/ha). Even the productive TNFDC reservoirs have not improved their performance. Aliyar, which for some years was managed scientifically by CIFRI attained a peak production of 62.530 mt (97.70 kg/ha) on FRL basis, (Selvaraj 1994) but has been going down from 1990-91 despite having the largest fish seed farm right below the reservoir. Amaravathy also reached a peak production of 142.430 mt in 1990-91 but reached a nadir of 53.885 mt in 1996-97. Bhavanisagar, one of the best studied productive reservoirs, also fares very unsatisfactorily, touching a low of 57.740 mt in 1996-97. The maximum of 340 mt was reached in 1982-83 when it was managed better. From 1980-81 to 1982-83, the yield exceeded 300 mt/year. Scientific studies based on primary production etc., indicated an expected higher harvest of over 400 mt/year (Sreenivasan 1995). Heavy poaching is one reason for the low yield from reservoirs managed by TNFDC. Inadequate management practices are the other reasons. Population management of various species should

Table I : Fish Yields from Major Reservoirs of Tamilnadu

Yield Years	*1988-89*	*1989-90*	*1990-91*	*1991-92*	*1992-93*	*1993-94*	*1994-95*	*1995-96*	*1996-97*	*1997-98*
Departmetal(Y)t	919	927	927	822	724	710	970	980	613	991
(R) Rs Lakhs	21.95	20.92	23.56	24.90	24.62	36.79	33.25	36.88	42.00	46.32
TNFDC (Y)t	733	510	829	623	534	752	990	669	462	427
(R) Rs Lakhs	60.87	44.88	62.97	64.03	69.24	99.04	84.41	126.00	71.97	86.91
Total Yield (t)	**1652**	**1437**	**1756**	**1445**	**1258**	**1462**	**1960**	**1649**	**1075**	**1418**

be undertaken. *Barbus dubius* should be induced to breed through hypophysation and restored to the reservoir. *Labeo calbasu* also needs to be restocked. The income from this reservoir nose-dived from Rs.53 lakhs in 1995-96 to Rs.7.32 lakhs. Both production and marketing deteriorated and a profit making reservoir turned into a loss making one. Palar-Parandalar is a very productive, manageable reservoir, which has been giving high yields - 23.210 to 142.43 mt (Average 84.67 mt/Year; 135 kg/ha). The revenue crossed Rs. one million in a few years. Yet the TNFDC leased out this reservoir to private parties in some years. Sathanur, the crown jewel among Tamil nadu reservoirs, has been giving consistently high yield of 80.05 - 169.10 mt (10 year average 134.01 mt at 108 kg/ha on FRL basis). In earlier years the yield exceeded 200 mt/Year but this tempo was not maintained. This had a high MEI of 42 (Sreenivasan 1990). Sathanur is the highest revenue yielding reservoir, exceeding Rs. one million for over 20 years, reaching a high of Rs.3.621 million in 1997-98. Two salient reasons for this are the high yield rate and the superior quality of fish caught - 90% being major carps. Competitive marketing by tender system fetched higher revenue. A redeeming feature of TNFDC reservoirs is that stocking is done judiciously and truthfully unlike departmental reservoirs where stocking is only "on paper".

Departmental Reservoirs of Tamil Nadu

A few examples of resrvoirs directly managed by the Fisheries Department is given in Table-II. In terms of yield, Krishnagiri tops the list. But after reaching a peak of 90.0 mt (70.30 kg/ha) in 1990-91, the yield has tapered off, reaching a low of 18.50 mt (14.45 kg/ha) in 1997-98. Indices of productivity show the reservoir to be a fairly productive reservoir. The percentage of major carps decreased gradually from 23.14% to 4.87%. If only stocking had been done as in Aliyar (Selvaraj 1990) the quality of yield would have been valuable. On the basis of primary production, this reservoir should yield 200 kg/ha. Yet the yield is lower (the area being the same as Sathanur) with "trash fish" dominating. This is a loss making reservoir, where even the cost of stocking is not realized.

The 870 ha Manimuthar reservoir is the worst managed departmental reservoir, yielding 1.75 to 10.06 mt fish per year (8.765 average; 6.74 kg/ha). Even an astatic one ha seasonal pond would have yielded better catches. The revenue was not even adequate to cover the cost of stocking. Ironically this has one of the best major carp hatcheries in the State. This is a case for "privatization" or leasing. The medium sized Petchiparai (1280 ha) reservoir is only slightly better than Manimuthar, the annual catch ranging from 13.0 to 26.2 mt (average 7.07 mt ; 13.33 kg/ha). This is one of the very few reservoirs having a good *Labeo fimbriatus* population. The yield should be around 64.0 mt/Year. Presently, the highest revenue from this reservoir is only less than Rs. 2.0 lakhs and this is a loss making reservoir. Vaigai is also a "medium" reservoir (area 2590 ha) but production is low -9.68 to 60.18 mt in the last 10 years (average 24.09 mt/Year or 9.30 kg/ha). Needless to say, the revenue is very low and this is a loss making reservoir. The Chittar pair of reservoirs have a combined area of 706 ha but the fish yield is dismal 2.26 to 16.07 mt in this decade (average 10.75 mt, 15.23 kg/ha). Like the above mentioned reservoirs, this is also a loss making one.

Some Small Reservoirs of Tamil Nadu

The Kovilar - Periyar reservoirs (each about 75 ha) have yielded an average of 7568-7972 kg/year. High yields of 736 kg/ha and 582 kg/ha were achieved in these reservoirs. It is possible to sustain this yield. The average revenue realised from these "mini" reservoirs is Rs.1,41,737/year from 1984-85 to 1989-90 but this is halved to Rs.6,56,801 in the years 1990-91 to 1995-96. This is not enough to sustain the staff employed. An assessment of fish production from 25 "small reservoirs" shows that they yield 776.5 kg/ha/year - 206.2 kg/ha (Sreenivasan 1999).

Even small irrigation tanks, when well managed provide satisfactory yields. For example in Barur Tank (214 ha at FRL), the pre 1990-91 year yielded low catches, ranging from 12.5 to 32.22 mt/year (68.46 - 150.56 kg/ha). In the next six years, 1990-91 to 1995-96, management practices were adopted with honest supervision and this led to yields with a range of 21.05 to 64.52 MT/year (98.4 kg/ha; average 229.9 kg/ha to 430.72 kg/ha). Revenue ranged from Rs.80,729 to Rs.3,72,692/year which is very satisfactory for the size of the reservoir.

The overall results of operating reservoir fisheries by the Fisheries Department shows a loss of Rs.5.11 lakhs during 1997-98. Since this activity does not serve any social or economic purposes, it would be advisable to lease out all these 45 reservoirs, except Mettur and Poondi. In the case of Mettur, the Mettur Dam Fish Co-Op. Marketing Society operates the reservoir fisheries paying only a fixed licence fees. The society makes good profits by a system of auction and pays its members reasonable procurement

TABLE-II : FISH PRODUCTION AND REVENUE FROM SELECT RESERVOIRS
Y = Yield M.T. R = Revenue (Rs.)

		1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98
TNFDC											
Aliyar	(Y)	54.30	62.530	49.37	46.01	40.84	39.06	29.540	47.620	42.215	35 650
	(R)	634,000	653,000	660,000	667,000	639,000	728,000	623,000	1,036,000	982,000	865 000
Amaravathy	(Y)	129.920	63.200	142.430	123.660	94.950	112.140	114.990	104.320	53.885	62 000
	(R)	851,000	454,000	1,148,000	1,017,000	1,314,000	1,957,000	2,323,000	2,179,000	1,049,000	1.461.000
Bhavani Sagar	(Y)	226.560	107.320	192.390	128.810	85.240	284.250	155.830	281.580	57.740	95 920
	(R)	1,921,000	1,064,000	1,361,000	1,155,000	986,000	2,896,00	1,914,000	530,000	732,000	966.000
Palar-Paravanda	(Y)	83.700	65.200	142.430	135.460	70.660	42.700	23.210	Private	113.960	Private
	(R)	656,000	454,000	1,138,000	1,376,000	891,000	681,000	947,000		No Data	
Sathanur	(Y)	169.610	145.320	105.690	105.720	165.550	140.480	80.050	142.640	133.825	151 230
	(R)	1,504,000	1,539,000	1,219,000	1,394,000	2,307,000	2,133,000	1,339,000	2,453,000	3,047,000	3 621.000
Deartmental											
Krishnagiri	(Y)	55.430	64.600	90.003	83.145	79.043	88.346	65.506	56.032	25.809	18.502
	(R)	186,478	223,000	304,120	200,326	241,689	241,318	239,642	356,324	219,117	153.597
Manimutharu	(Y)	5.51	6.60	5.52	1.75	4.43	10.06	3.44	7.60	9.00	4 74
	(R)	18,000	30,000	26,000	10,000	12,000	85,000	39,000	113,000	12,000	90.000
Pechiparai	(Y)	15.40	19.02	12.83	25.50	26.28	15.03	15.34	13.00	13.50	14 79
	(R)	42,000	48,000	46,000	137,000	141,000	92,000	113.000	137,000	154,000	190.000
Perinchani	(Y)	12.06	25.33	5.75	2.75	5.0	1.74	3.39	51.20	1.95	7 91
	(R)	127,000	49,000	13,000	69,400	21,000	14,000	34.000	183.000	74,000	5 000
Vagai	(Y)	60.18	11.99	39.13	23.55	9.68	17.07	18.01	17.80	21.26	22 20
	(R)	214,000	50,000	203,000	137,000	44,000	80,000	113,000	141,000	238,000	260.000
Chittars	(Y)	16.07	15.04	10.86	9.29	7.99	14.07	15.01	10.41	6.53	2 26
	(R)	62,000	60,000	50,000	41,000	41,000	94,000	104,000	105,000	80,000	53.000

price. It would be reasonable to charge the Society for the fish stocked.

The TNFDC earned the highest revenue of Rs. 12.60 million in 1995-96, which decreased considerably in 1996-97 and 1997-98. Unfortunately, the Corporation dumps some reservoirs back in the lap of the Department when the results are poor (for eg., Uppar, Palar Pavandalar etc.) The TNFDC must convert itself to an Inland Fisheries Development Corporation and develop and operate all reservoirs on commercial lines.

Status of other Reservoirs in India

Most of the reservoirs in India have not come upto expectations, though many of them are in operation for over 3 decades. The ICAR implemented a Co-ordinated Project (AICRP) for developing reservoir fisheries. But despite the immense scientific inputs, not much could be achieved in terms of increasing the yields and revenue because the State Governments did not show any commitment, nor have they extended full co-operation to the lessees. A bright and successful exception was the project implemented by the CICFRI in Aliyar where honest and scientific management led to increase in yield with the high quality fish (Selvaraj 1990).

One of the best managed reservoirs in India is Gobindasagar which has been giving consistently high yields - 105 kg/ha, which is seven times the national average. (Anon. FC 17(1) 54.1997). From a yield of 337 mt in 1986-89, it has risen to 1015 mt later with a value of Rs.205.81 lakhs and a profit of Rs.32.59 lakhs to the Government. Management by a single competent and motivated scientist could achieve this. But in Pong reservoir in H.P. the yield of 797 mt in 1987-88 decreased to a mere 397 mt in 1996-97 (Kumar 1997). Dudhawa Reservoir in M.P., gave yields of 94 kg/ha. The large Gandhisagar reservoir in M.P. yielded 342 mt in 1994-95, employing 1116 migrant fishermen, fetching Rs.199 lakhs. The Matsya Vikas Nigam managed M.P. reservoirs with scientific inputs. Sarni Reservoir, also in MP, gave high yields from 1976-77 to 1992-93 - 66,652 kg to 65,080 kg i.e. 64.3 kg/ha). The fishermen earned Rs.17,799/year which is satisfactory (Chatterjee *et al* 1994). But Ravishankar Sagar yielded a very low catch of 2.04 - 8.3 kg/ha (Desai 1994). Madhya Pradesh has the distinction of promoting reservoir fishery development supported by high scientific and managerial inputs, right from the time of Dr. G.P. Dubey set standards when he was Director of fisheries of the State. Contrary is the case in U.P. where the reservoir catch was very meagre (Ranjan Saxena) - 8 to 10 kg/ha. Rihand reservoir was also low in fish yield - 2.26 - 10.91 kg/ha upto 1980-81 (Desai 1998).

Tungabhadra Reservoir yields a high catch; 3160 mt in 1980-81 and 2068 mt in 1986-87 (155 to 91.18 kg/ha/year) but over 95% of it is "trash fish". A decline in yield is also noted. The best way to manage Tungabhadra is to completely fish out all the trash fish in one or two years and start stocking major carps heavily, taking the risk of income loss for a year or two. Kolleru has been overfished. The catch of 20,000 mt in 1983 crashed to just 330 mt by 1990-91 with the average weight of fish dwindling from 3-4 kg to 0.75 kg. According to Sugunan (1995) the average yield from AP reservoirs is 36.48 kg/ha.

Bihar holds the record for the lowest fish yield from reservoirs, 0.54 kg/ha, though it is the third ranking fish seed producer (Sugunan 1995). According to Sugunan (1995), "reservoirs of Bihar have one of the lowest fish yields in the country", 0.54 kg/ha. Rajasthan reservoirs have been managed well by the Tribal Area Development Federation (RTADC). Jaisamand has been yielding 200-287 mt/year (40.1 kg/ha). The 750 member RTADC earned Rs.18.75 lakh/year and the Government got a net income of Rs.17.16 lakh (Sharma K.P. 1986). Now the RTADC has 2300 members (Kulshreshta 1990) each fisherman earning Rs.17,000/year. This is similar to the co-operative fishing and marketing in Mettur Dam in Tamil Nadu. In Tawa reservoir of M.P the fish production increased from 136.7 mt in 1990-91 to 344.4 mt in 1998-99 because of management by Fishermen's Co-operatives. Such Co-operatives and Corporations promise good fishery yields, higher employment opportunities and income generation, and these are worthy of emulation elsewhere in India. Some NGOs also manage the fishery better as seen in Tilaiya reservoir where the yield was hardly 5 kg/ha while under the control of Central Fisheries Cororation and of the local Government but rose to 28 kg/ha under the management of a NGO (Kumar & Yadava 1997). Nagarjuna Sagar in A.P. has been continuously giving low production, not exceeding 10 kg/ha. Despite having rich species diversity and also being mesotrophic, according to Sugunan (1995), the administration missed proper management. Natarajan (1979) predicted a yield of 3408 t/year. In Karnataka, the total fish yield from reservoirs declined from 1613.629 mt in 1993-94 to 938.904 mt in 1997-98. Fish yields in Kabini and Krishnaraja Sagar decreased, but the catches from Markonahalli, managed by CICFRI increased from 5.56 kg/ha to 62.77 kg/ha through scientific supervision. Catches from Ukai reservoir in Gujarat shot up from 863 mt in 1983-84 to 3989 mt by 1988-89. This is encouraging result of organizing a tribal Fishermen's Co-operative.

The survey presented above is not all inclusive but only selective. The plus and minus points have to be evaluated and proper management techniques and technologies adopted to boost the yields.

Fish Yields from some Asian Reservoirs : India's Position

De silva (1988) has summarized the fish yields from some Asian reservoirs as follows :

India 20 kg/ha; Indonesia 177 kg/ha; Thailand 47 kg/ha; Srilanka 283 kg/ha; China 150 kg/ha. Thus India is at the bottom of the list though the scientific man-power in fisheries sector of India is very high. The Chinese treat reservoir fisheries as "culture" fisheries and it is the only country in the world where culture fisheries exceed capture fisheries. They consider hydrobiology as key to fishery management (Liu Jian Kang 1992).

Even the cold water fisheries of China produce 19.5 - 205.5 kg/ha. In Sri Lanka, the upland reservoirs like Kotmale, Victoria and Randenigala, yield 38 kg/ha, 70 kg/ha and 50 kg/ha respectively. (KHGM De silva 1992). They have stated that these yields are, by and large, in conformity the prediction of Sreenivasan and Thayapavan (1986). "Cove Fishing" is very productive in Chinese reservoirs, yielding 7579 - 7695 kg/ha of marketable fish. This system can be adopted in reservoirs like Mettur, Nagarjuna Sagar, Hirakud and other "dendritic" reservoirs. Thai reservoirs are reported to yield 73.24 kg/ha (range 37-241.8 kg/ha) (Pawaputanan 1986). We must catch up with other Asian countries in reservoir fisheries.

Perspectives for Development of Reservoir Fisheries

The broad ground rule for scientific development of reservoir fisheries was laid down by Dr. B.Sundera Raj in the thirties of the previous century and this has been elaborated by Sreenivasan (1998). Beginning with pre-impoundment studies - fisheries and limmology - establishment of a fish seed farm at reservoir site, is the basic requirement. Based on ecological considerations such as the effect of dams on indigenous fishery, introduction of fish specially compatible with the new environment has to be undertaken. Transbasin introductions such as Catla, Rohu, Mrigal, Calbasu etc. in southern reservoirs is a case in point. Stocking with well grown fingerlings of size 12 - 15 cm is needed to provide for higher survival and to supplement for the failure of breeding species. An initial fishing holiday of 3-5 years is needed and later a short fishing holiday during peak spawning season is a necessity to conserve the stock. This is enforced in some reservoirs like Gobind Sagar, Jaisamand etc., with very favourable results. Mesh regulation as appropriate has to be enforced and fishing effort has to be fixed. Over exploitation through increased fishing units has reduced the CPU and so the income of fishermen, in addition to depopulating the fishery. This is observed in quite a few reservoirs in Tamil Nadu and elsewhere. A specific case in point is Sathanur Dam. Here, because of the high price fetched by large Catla, only meshes of over 5" were being preferred by fishermen leading to the yield of Catla to the extent of 90% of total catch and all the stocked Rohu. Mrigal, fringe-lipped carp (*Labeo fimbriatus*), *Cirrhinus cirrhosa* were excluded from the catch. Prabhavathy and Sreenivasan (1976) recommended the use of gillnets of mesh 2.5" also as a result of which rohu, mrigal and other major carps were also being caught to the extent of about 50% of total catch.

The aim of fisheries management is to obtain maximum sustainable yield of desirable fish species. Broadly speaking, management should include stocking, introduction of compatible species, legislation to prohibit non-selective small meshed gear, enforcement of closed seasons, population manipulation, water regulation, fixing optimum fishing effort (units), pollution control and above all prevention of poaching. Introduction of exotics should be avoided. Sound marketing system will fetch higher incomes and enthuse the fishermen to increase the catches. The examples of success stories of co-operatives mentioned in this paper (for eg., Mettur, RTADC, Matsya Vikas Nigam, etc.,) should spur the departments to organize such co-operatives for reservoir fishery.

The existing stagnation should be overcome.

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Industrial Development of Wetland Fisheries

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While wetlands came into existence with condensation of water on earth, it was left to the International convention on wetlands in Ramsar (Iran) to focus attention on swampy large water tracts which required conservation of its environment and protection to flora and fauna. 25 member countries signed in 1980 and the signitaries increased later to 91 by 1998. India became a signitary to the convention in 1982. The Convention held in Kushiro, Japan in 1994 introduced "Fish criteria" for the first time for consideration in connection with wetland conservation. In Brisbane (Australia) in 1996, 774 Ramsar sites were identified of which 6 were on "red alert". Chilka in Orissa was one among these. The convention made an important recommendation that Environmental Impact Assessment be taken up by member countries. India issued a notification in 1994 in respect of 21 sectors but this did not include wetlands.

There have been many definitions of wetlands. They usually convey the impression of marshy swamps retaining water all the year round or remaining wet for short periods. A Bill introduced by the Government of West Bengal on wetlands specifies water areas of 0.035 ha or more were not to be filled up but utilised by fishermen's co-operatives.

Wetlands have been estimated to cover 6% of earth's land surface but these are disappearing rapidly. It has been lately realised "wetlands have amazingly high productivity, higher in some cases than lush tropical rain forests" Some of the major functions like support for wild life, control of flood, natural sewage treatment, protection of shore line from wave effect, restoring water contents of aquifers, support for several types of food chains etc., are now well recognised. Foote *et al.*, 1996 have enumerated some of the factors of loss of wetlands. These are : agricultural conversion, direct deforestation, hydrologic alteration, inundation, defoliation, altered upper water sheds, accumulative water demands, water quality degradation, wetland consolidation, global climate change, ground water depletion, and exotic species and biological diversity. Steven *et al.*, in connection with the regulation on Wetlands and Coastal Zone estimates that the coastal zone in USA is 10% of the area but 75% population is within 50 miles of this and says "Wetland development will surely be a major environmental issue".

Editor of Science Express, in issue of 12 Jan 1999 says : "Traditionally wetlands have been viewed as ecosystems associated with disease, difficulty and danger. But ecologists realise they are actually amazingly productive and just waiting to be tapped". To this must be added the glaring example of the construction of Salt lake city of Kolkata having *Bheries* (Commercial sewage fed fish culture tanks) with an extent of 18,000 acres employing 12,000 fishermen, as part of it. This area acts as sink for urban waste through absorption of sewage, air pollution and fish production.

Although the role of Fisheries in the utilization of wetlands in establishing self - sustained economy may be limited, a few examples of their useful role are available. Mudially *Beel* near Brace Bridge Railway Station near Kolkata integrated with aquaculture and capture fisheries is cited as an example of sustainable management of city-side wetlands. The sewagefed fisheries (extensive fresh water Bheries) in Kolkata "act as sinks for urban waste through absorption of sewage, air pollution and fish production". In France, a 13th Century lake of 1500 hectares plays the role of coordinating various interests. In India, fisheries of Chilka lake in Orissa have been self sustained till 1993/94 after which production came down by 40% but the fall in production had not been contained. Kolleru lake in Andhra Pradesh has at present a highly productive farm-based culture fishery but there are complaints that this is taking place at the cost of environment.

Several methods have been adopted to make marshes productive in some form or other but high cost of reclamation and conservation of the flora and fauna along with ecological parameters has prevented the onset of a sustained economy. In one case in USA, which was under study for 12 years 'ditching produced shrubby growths succeeding the marshes' natural vegetation and greatly reduced invertebrate population so important as water fowl foods".

In India, accepting the definition of any waste water area as a wetland, an estimate has been made of area under tanks and ponds as 2.2 million ha, and swamps comprising of *beels*, ox-bow lakes and derelict areas as 1.3 million ha. Besides, in the coastal areas 1.4 million hectares are said to be under brackish water. The state of Orissa has approximately 0.18 million hectares of fresh water swamps. A survey of Orissa tanks made in 1946 showed that more than 70% of the tanks were in swampy condition which added to the area of the swamps.

Orissa fisheries department conducted various experiments between 1950 and 1963 to develop fisheries in the derelict tanks and swamps into self sustained culture fisheries units. Construction of fish farms in Chilka area for shrimp culture was taken up subsequently. Mass scale development of tank fisheries under supervision of Fish Farmer Develop-

ment Agencies started in 1981. The following are the brief results of the experiments in Orissa - failures and successes - which give guidelines for future approach. Experiments were based on knowledge available at the time, traditional experience being supplemented by scientific findings as these were made applicable.

The swampy water areas of the State were characterised into 1) Tanks depending on ground water, 2) Enclosed swamps serving as drainage without connection with any river, 3) Swamps as a part of the river system, and 4) Mangrove swamps. Different technologies in reclamation and culture were adopted. Mangrove swamps converted into fish farms did not prove economical on account of defects in construction.

Fish culture situation in Orissa

Surveys conducted between 1941 and 1945 showed that, collection of spawn was limited to Subarnarakha, Brahmani and Mahanadi by spawn collectors from Midnapore and Calcutta, (now Kolkata) all of which used to be taken away to Calcutta market for sale outside Orissa State. The fish seed available was only from flooded water areas in the form of fingerlings. The collections and supplies were very limited and expensive. Barring a few fish culturists in Balasore District which was the border with Bengal, there was hardly any fish culture as such. Tank owners used to collect, whatever fingerlings they could, and stock their tanks in the coastal districts. Some mixed fry used to be sold in mud pots brought by fishermen from Bengal. In this situation, it was quite apparent that instead of the industry demanding assistance from the Government, it should have been the role of Government to attract industrialists and try to promote such self sustaining ventures.

Before attempting any industrialisation, supply of seed at a reasonable cost was essential. Research at the time by ICAR scientists achieved a good survival of spawn collected from rivers in nurseries to fry stage which reduced the cost of production of fish seed. A scheme was taken up to introduce fish culture in tanks under Gram Sabhas (called Gram Panchayats in Orissa) on a self sustaining basis.

Experiment in Gram panchayat Tanks: These tanks were taken over from the Zamindars (landlords) by the Government and given to the custody of the Gram Sabhas for development. They were to reclaim the tanks with a subsidy of 25% on reclamation costs. Seed was to be sold at Government subsidised rates. The scheme did not work well, recovery being hardly 35% of the investment. Reclamation had not removed the acid slushy soil in the deeper zones of the tanks and production varied between 100 to 325 kg/ha. This was a case of failure in technology of reclamation.

Reclamation of swamps for fish culture by the Fisheries Department: This scheme was taken up with some confidence and with the help of an ICAR team of scientists a technological package had been evolved for profitable fish farming. Supply position of good seed had also improved. Economic analysis of the feasibility of this scheme as a commercial venture had shown that not more than Rs. 2500 would need to be spent for reclamation per acre as capital on the basis of current estimated income. The scheme was to take over private swamps on lease for 20 years and reclaim them with governmental funds. Fish culture was also to be undertaken by Government till the costs were recovered after which the reclaimed units concerned were to be returned to the owners. It was a bold venture. The scheme was taken up on a large scale all over the state in all such areas where nursery centres had been earlier created. Some State-owned swamps were also included. Soil types were quite different from place to place, so also the technology of reclamation. After simple excavation, the top soil, kept separately, was spread back at the bottom of the tank. Excavation was not resorted to if the pH of bottom soil was near neutral. It was resorted to only when deepening was necessary. Reclaimed areas belonging to Government were made into demonstration centres and later hatcheries were added for producing hormone-bred spawn of carps. 25 private tanks were reclaimed in this manner and with due manuring and put under fish culture. Feeding was also resorted to as recommended by of central government ie., scientists of CIFRI. All works were done through labour under contract directly ensuring proper reclamation. All the private tanks could be handed over back to the owners after reclamation but some tanks with poor soil required as much as 15 years to be returned back to the owners. Production, however, was still low between 800 to 1000 kg per hectare.

New techniques had been developed for the reclamation of swampy lands. Power deweeding with winches and dragging devices evolved for specific weeds under a state scheme of research financed by the ICAR had been successful in reducing costs of management of weed control. This was far less expensive than either chemical or manual removal of weeds. Large swamps like Kausalyaganga or Kiakani and Kanjia (now taken over by the Nandankanan park) with an area of over 100 ha. presented special problems of keeping the capital expenditure at Rs. 2500 per acre.

Kausalyaganga: Originally a one sq. mile tank about 1000 years old, the area had been reduced to 180 hectares over years. It was heavily silted up and the surface was totally shielded by water hyacinth on which cows could graze and poisonous snakes were there in good numbers as was seen later.

Dredging and bringing the dredged material to the shore was found too expensive, so also dividing the area into long strips by erecting earthen bundhs of silt taken out. The engineering advice was to drive piles and make the dykes. Piles would retain the silt and consolidate it into bundhs. The estimate came to more than Rs. 30,000 per acre as against Rs. 2500/- without piles. To get over the problem a new technique to dispense with the piles was formulated. Essentially it was to lower the water table and keep it low so that a hard crust of at least one metre thickness was formed. A wide berm of solid silt could be carved

out to retain the silt. This new technique dispensed with the need for piles and the cost was within the stipulated estimate. Maintenance of tanks free from weeds was done with the help of two special winches.

The farm had been designed specially for commercial exploitation. Nurseries and rearing tanks were set up in parallel contiguous rows to facilitate transfer with least labour costs. So also stocking tanks were planned to facilitate supply of feed and operation of winches with minimum expenditure on labour. An earthen ring road was formed to facilitate communications and movement of watch and ward. The farm was connected to the Daya river by a channel through which there was some recruitment of fish from the river. In order to eliminate predators and others a special sluice with traps had been constructed after experimentation with various models. Although the farm was finally made into a demonstration and research centre, there were attractive offers take the farm on lease which indicated the success of the reclamation work.

Kiakani and Kanjin: With a cover of thick mat of grass enabling cattle to graze, the technology evolved was to cut the grass patches into square slabs and pull them to the shore with a winch, the slab acting as a raft. Part of the swamp has been taken over by the Zoo at Nandankanan, the rest being utilised commercially by a fishermen's cooperative. This technique is suitable for many Beels in Assam, as surveyed by the author.

Ainsupa Lake: This lake of about 150 ha was created out of the Mahanadi basin and used to be auto-stocked from the Mahanadi every year during floods. Submerged weeds, mainly Hydrilla was killed by a mud cover formed due to flood water. It supported commercially two fishing villages, apart from supplying water to rice fields. After the channel to the Mahanadi was closed and flooding became rare after construction of the Hirakud dam there was heavy infestation of Hydrilla. This together with no stocking of seed substantially reduced fish harvests. Weeds were cleared in a week by the author using two winches and the fishery revived after stocking. This was in 1956. In course of time, silting that took place after the entire tree belt was wiped out and because of encroachments of the bed by agriculturists, this small lake has now become a swamp. A positive factor is that industrialists from outside Orissa are interested to invest capital over the 'swamp', as this area has great potential for a commercial fishery. Ventures of this kind require a clear cut lease policy and it is commendable that Orissa has declared fish culture as an Industry.

Lakhisagar: This swampy tank with an area of about 10 ha, fully covered by both floating and submerged weeds, required excavation. This tank had a very high water table and under-ground springs started filling the area all over when removal of silt was done, making the bed slushy all the time, for the reason that the water table could not be lowered. Unfortunately, this swamp could not be reclaimed within the budget beyond deweeding. Despite deweeding, it had reverted to its original state in three years. The weeds were cleared again in 1994. For this type of tank a suitable economic reclamation technology has to be developed. The tank has access to sewage and this is an advantage for making it highly productive.

Badapokhari: This was a small swamp having only one ha of water area with a depth of 1 to 1.5 m completely was choked with water hyacinth and also some Otellia and Hydrilla. This was reclaimed in 1956 by the same technique as evolved and applied in Kausalyaganga and stocked with advanced fingerlings specially selected after ignoring the ones with lesser growth. The tank was returned to the private owners within a few years but it again fell into neglect as there were multiple owners. In 1995, with the permission of the owners the author took it over for an experiment in low cost commercial fishing in a reclaimed swamp. Nearly 40 years of reclamation, it is now again covered with a thick mat of water hyacinth. Soil pH was 6.8. There was a 9" thick layer of humus covering the soil surface at bottom. The weeds were cleared and a pilot stocking (as the tank was handed over only after October) programme with juveniles was taken up. There was no liming and manuring apprehending a phyto bloom in summer, but the humus at bottom was thoroughly raked up which made the water alkaline. Only monitoring that was done was in respect of pH with pH paper and for plankton content with a plankton net. Plankton was assessed by the colour to determine phyto or zoo plankton in quality. A three ft wide margin with water hyacinth was left undisturbed and its rate of growth noted weekly. It was argued that so long as water hyacinth grew rapidly there was enough nutrition and there was no need for expenditure on feed. Next season, commercial operations started with a bank loan, fingerlings of good quality were stocked, there was no manuring, some feed was given after tying bags of feed to bamboo poles in the middle of the tank. Production nearly was three tonnes fetching a handsome return of 200% to the owners. Subsequently the tank was leased out. The latest report is that in the past three years it had paid a dividend of Rs. 4,00,000 to the owners. The tank had retained its productivity even after this long period. There were also certaiin advantages like a good slope of the banks surrounded by a belt of trees, inflow of some domestic sewage water, and a good market in Cuttack city which is only 15 km from the tank.

Discussion and Conclusion: For their development commercially with the help of fish culture, swamps can be divided into two types: i) Swamps where conservation of wild life, migration of birds and other environmental factors have to be balanced as in Chilka with fisheries development requiring considerable objective research combining many disciplines. Many common programmes for fish, birds and other animals can be evolved, so also the environmental monitors. The problem becomes acute when a large body of fishermen are dependent on fishing in the lake. and ii) Swamps that need to be maintained in good condition and brought under fish culture on com-

mercial lines. While this is simpler, it requires a few dedicated owners for integrating harvesting and marketing operations. The integration is also needed for rearing of spawn by individuals, with marketing undertaken by a central organisation. An experiment was taken up in 23 tanks of villages Singmapur and Jamalpur in the district of Cuttack to clear the small tanks and use them as nurseries. Spawn was sold by the Government and technical assistance given to the buying farmers in respect or rearing spawn which was sold at government rates through centralised marketing system. The profits were more than 100% for the owners.

This system was emulated from the spawn industry in Bengal. Spawn collected from rivers or obtained from hormone breeding operations has a central market in Calcutta. But fry was being sold individually in *Handies*. The Bengal Fish Seed Syndicate, a private organisation, assembled the fry at a central place. It introduced quality control. This system led to emergence of fry rearing as a separate industry. Taking this example several companies are now operating on the same lines. This type of marketing has kept Bengal at the top of fry suppliers in India. Fish Seed Corporations, in addition to being producers, could also take up central marketing. Some capital has to be provided to the spawn rearers. Women could take up the rearing work by having ponds in backyards their houses. Another example of this growing industry is the rapid growth of hatcheries in Assam.

It will be generally agreed that any self-sustained commercial scheme requires application of technology, capital for supplies, infrastructure, market and above all skilled manpower. In this context, it has to be mentioned that as had been done in respect of Green Revolution, Technology and organization must be rendered equally efficient and progressive.

As is known, fisheries Research started late in India and as yet there is no clear cut policy of the Government regarding utilization of Wetlands of various categories. It is time for a review of the present status and short comings of fisheries research in India. Fisheries Research is still scientist-oriented without a focus. It has to be focal and need-based. Results are diffuse and there is no planning of research on the basis of establishing different categories of commercially-oriented fishing industry. Hitherto, only limited efforts have been made to take up sustained fish culture in reclaimed swamps due to high capital and maintenance costs. Taking into account the rich fertility of some of the swamps, specifically, and the favourable tropical conditions that provide fertility to land and water in most parts of the country in general, coupled with the development of advanced technology of culture of carps and technology for economic reclamation of some types of swampy areas, it is time that more attention is paid to large swamps both by objective research and organisational support. In the coastal belt, swampy tanks abound but not utilised due to multiple ownership and various other reasons. These obstacles can be overcome, once government announces a firm policy in this respect. It can be recalled that the Fish Farmers' Development Agencies were created with the specific purpose of making fish culture sustainable after subsidising capital, designing, and supply of seed and feed for one year, besides providing technical advice. The experience of the author in Orissa has been that only a small part of the effort on the part of FFDAs has been self sustaining for the reason that most of the owners are perfunctorily interested to continue fish culture as they are engaged otherwise. Further, seed supply comes late in the season from Government farms in Orissa. For this reason the owners fall a prey to peddlers from outside. There is also the absence of management of weeds or supply of feed after the first stocking, and lack of adaptive technology as recommended. Stocking rates have to be decided judiciously which is not being generally done. Inadequate training to farmers and inadequate experience of extension officers are partly responsible to these drawbacks. The reported figures of average production from FFDA supervised tanks in different states confirm that the expectations from the scheme have not been fully met and the logistics require a review both from the point of view of technologists and the operators. Several hundred case records by independent observers indicate much lower production from tanks than claimed.

Continuation of intensive research in a refined manner is necessary on ecology of swampy areas from all aspects so that a proper cropping programme can be drawn up. On the operational side, due attention has not been paid to towards evolving economic means of reclamation, management of weeds at low cost, and designing of more effective fishing gear requiring less man power as at present (at present netting operations cost as much as 25% of the gross production in Orissa). Market survey and upgraded technology of culture amanagement are also needed. We have to develop the cheapest and at the same time effective feed and feeding schedules for different stages of growth of fish.

Apart from the above considerations, for making fish culture in a swamp commercial viable, diversification of culture systems is a must. Swamps that are to be preserved, giving first preference to wild life, needs to propagate fishes of that category. Such species have to be chosen with care and supply of seed of the species made available to farmers. Mostly air-breathing fishes fall under this category and the raising of seed of these species needs emphasis. Production of these species in the Kosi river basin needs detailed study, if not already done.

Any industrial culture fishery operation to be effective requires an operational period of 200 to 250 days in a year. Carp spawn in Eastern India can be used to take out 3 crops of fry/fingerlings. During the remaining period some other crop of value can be taken for which more than six months would be required. Research planning has to give priority to develop breeding technologies for such species to be undertaken in the lean season which will give another crop geared towards a particular seed production indus-

try after detailed survey of problems faced and likely to be faced. Bengal nursery operators undertake production of seed of air breathing fishes for the next six months in the remaining period to balance their budget.

Availability of good seed as opposed to unmixed seed is a must. At the moment hormone-bred seed is gradually going into disrepute as inbreeding of the same batch of fishes year after year seems to have retarded growth. This needs scientific confirmation.

Disjoined observations on the same subject at different places is not sufficient for an industrialist. One example is Chilka lake of Orissa on which not less than 200 papers have been published on taxonomy and environment. But there is no paper which has recorded recruitment and outward migration of fishes so far. The lake is not polluted as yet. Cyclones periodically have a check on weeds, salinity in some areas is still within limits, but silting has reduced the area. At the same time the migratory species entering into the lake would have sharply come down. Juveniles of prawns are being removed in thousands for stocking outside farms probably depleting the lake thereby. All these are mentioned here to show that a holistic approach for research is necessary to develop and utilise a particular wetland on commercial lines. Research programmes need a second look in perspective planning making it industry-oriented (which is a need) and not so much "Scientist-oriented" giving priority to such areas which can be developed early. The Mahanadi system, of which a rapid survey was made, has revealed the swamps created by it and also depletion of fisheries it led to in one such area. Chilka is another example of fishery depletion.

As stated earlier, for fishing industry except shrimp export, government has to take the lead. State fisheries department is the executive agency and any technology developed must go to the state, if necessary, with a properly trained extension worker from the Central Organisation concerned. This worker should have to be with the scientist for a suitable period to acquire depth in knowledge. Short term training of State extension workers has to be avoided.

Problem of utilisation of swamps with sustained survey of required parameters concerns all Institutes and not any particular one. If a project is selected the scientists can be drawn from the entire Organisation besides technical persons from the various States. The author's experience in Orissa has been that there is very little money available in the State for research. In this situation, field trials of research results developed elsewhere can be modified to suit local conditions for extension. This type of holistic approach has to come from the central organisations.

Summary and Conclusion

1. With the developments in technology of carp culture and reclamation of swamps with a low water table, detailed preparation of feasibility reports may be made by experts drawn from various disciplines associating a state representative in the formulation of the reports. The pay-back period will permit the state government to specify the terms of lease.

2. Environmental parameters in a selected wet land should be studied in depth simultaneously and correlated with fish population dynamics at the same time, which will also cover socio-economic problems. This will determine the more important parameters requiring continuous monitoring and frequency of the same.

3. In large wetlands where wild life is to be preserved, migration of birds is to be protected, and at the same time fisheries have to be improved. It is essential that experts from different disciplines chalk out a common programme of research and monitoring of common factors. Where necessary experts in Agriculture and Horticulture may be invited to participate.

4. To develop wetlands that provide a livelihood to the local fishermen exploiting air breathing and weed fishes, population of the desired species may be augmented by establishing hatcheries, rearing of fry in special enclosures and supplementing the food supply. This type of wet land would require development of breeding of the desired species on an economic scale.

5. Survey of tanks under supervision of the FFDA organisation has indicated that a good percentage of them has reverted to swampy conditions. A technical review of the scheme from all aspects is urgently necessary to ascertain the causes of reversion, to revise the technology where necessary and to go into the difficulties of the owner and the extension staff.

6. A freshwater biological station like CIFA may take up craft and gear research for the benefit of inland fishermen and to reduce cost of fishing in harvesting operations.

7. Evaluation of short term training courses to enable the beneficiaries to be self employed be made and follow up action taken to assist them further where necessary.

8. Recognizing the need for technological development to be combined with infrastructure, finance, skilled workers, market and other relevant matters to produce sustained development, greater collaboration of research institutes with state authorities is essential.

9. Realising that many valuable findings of scientists which, with a little more effort and vision, would have led to establishment of industrial fisheries, it is necessary that scientists engaged in applying science to technology be enabled to carry on the work to a stage when entrepreneurs can be taken as apprentices of the scientists either in pilot plants or in the field.

10. Simple monitoring instruments, aerating and such other implements like winches, mud pumps to clear the metabolites, be devised at a cheaper cost for the small operators

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Marine Products exports move up

According to MPEDA, Marine products exports have grown by 23.3 per cent and touched Rs. 6,300 crores in 2000-01, according to provisional figures released by the Marine Products Exports Development Authority. These exports were Rs. 5,117 crores in the earlier year.

In dollar terms, the value of exports was $ 1,387 million against $ 1,189 million during the previous year. This 16.6 per cent growth in dollar terms is an all time record for marine product exports.

During 2000-01, the quantity of marine exports rose to 4.21 lakh tonnes (3.43 lakh tonnes), showing an increase of 22.8 per cent. The previous best figures were in 1997-98 when 3.85 lakh tonnes valued at $ 1,296 million (Rs. 4,697 crores) were exported.

Chennai Port stood first in terms of value of exports followed by Kochi and Visakhapatnam. All the major ports except Kochi showed an increase in value of exports.

Exports through the Kochi Port dropped to Rs. 1,031 crores in 2000-01 from Rs. 1,137 crores in 1999-2000. The share of Kochi had also dropped from 37.9 per cent of total value of exports ten years ago to 16.3 per cent in 2000-01.

As per the export trend available in the first eleven months, the main increase has come from exports to the U.S. The increase in exports to the U.S. over the previous year is nearly 55 per cent, in terms of percentage share, the U.S. has now overtaken the European Union to attain the second place.

Japan, with 41 per cent maker share continues to be the number one, followed by the U.S. with 18.6 per cent and the EU with 15.3 per cent. There was also substantial increase in exports to China, which along with Hong Kong, now has 12 per cent market share.

Shrimp continues to be the number one commodity exported, accounting for 71 per cent of the value of exports, although in quantity terms the share is only 26.8 per cent. An interesting feature is the rise in quantity of shrimp exported, in spite of stagnation in catches from the sea and the disease and other problems in aquaculture farms.

The share of finfish in the export basket is now 12.6 per cent, mainly because of the increase in export of low value forzen ribbon fish to China which has gone up by over 100 per cent when compared to last year. Cuttle fish and squid account for 5 per cent each of the value of exports.

Another feature of the exports this year has been the rise in value added items, which is a welcome sign. Export of surumi, a product manufactured from trash fish has gone up by over 110 per cent, making India one of the major players in the surumi market.

Larval Rearing of *M.rosenbergii* (De Man) through Hatchery Units in Coastal Areas.

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Problems encountered in brackishwater shrimp farming have generated an awareness towards diversification into other systems of culture. One such system preferred is gaint freshwater prawn farming. A major hurdle encountered by entrepreneurs to switch over to freshwater prawn farming is the non-availability of adequate quantity of seed of the gaint prawn. This hurdle can be removed by producing the seed through setting up simple hatchery units, as has been accomplished by the author. In setting up hatchery facilities and their usage, the expenditure was kept to the minimum without in any way sacrificing efficiency of seed production. The output out of the experiments was, however, 25% of the expectation. The reasons for this are attributable to the long rearing period and occurrence of low temperatures. It is nevertheless felt that the procedure adopted in rearing to obtain post-larvae is quite suitable for operating hatchery units of the type established by the author in required numbers and of needed capacities at identified conducive locations, for commercial production of seed to meet the present demand in the State.

The hatchery was set up at Paradeep in Cuttuck district of Orissa. Two experiments were conducted on larval rearing of giant freshwater prawn, *Macrobrachium rosenbergii* (De Man) at the hatchery. Though maturity and breeding of *M. rosenbergii* takes place in freshwater, as is known, its larvae require brackishwater till they reach post larval stage. (Fig 1). Considering this, efforts have been made to ensure that the newly hatched larvae have the same water conditions as in their natural habitat and environment in the river system while selecting the materials and formulating the method of work to be adopted for the two experiments conducted.

Materials **:** The following were the materials assembled for conducting the experiments.

a) One plastic fibre pool of 2 ton capacity for storage and seasoning of sea water.

b) Two 30 litres capacity plastic fibre pools for larval rearing.

c) One 450 litres capacity plastic pool for use as hatching tank.

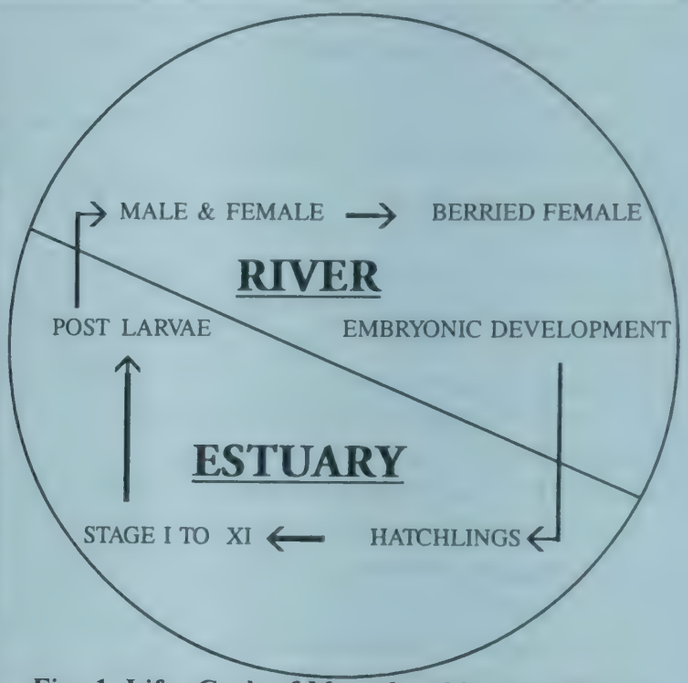

Fig - 1: Life - Cycle of *Macrobrachium rosenbergi* (De Man)

d) Two aquarium air-pumps for aeration of the hatchlings in rearing pools.

e) A refractometer for monitoring the salinity of the water used for rearing.

Water and Brooder Source: Saline water was sourced from the sea. Freshwa-

TABLE - I. Feeding Schedule

Stage	Time Schedule				
	6 Hours	*10 Hours*	*14 Hours*	*18 Hours*	
	Egg Custard gm/1000	*Egg Custard gm/1000*	*Egg Custard gm/1000*	*Egg Custard gm/1000*	*Artemia Nauplii/Larvae*
I,II	1.0	1.0	1.0	1.0	-
II,III	1.0	1.0	1.0	1.0	-
IV,V	1.5	1.5	1.5	-	5
V,VI	2.0	2.0	2.0	-	8
VII,VIII	2.0	2.0	2.0	-	10
VIII,IX	2.0	2.0	2.0	-	15
IX,X	2.0	2.0	2.0	-	20
X,XI	2.0	2.0	2.0	-	25
XI,PL	2.0	2.0	2.0	-	25
PL	2.0	2.0	2.0	-	30

TABLE - 2

Rearing medium 1

Date	Larval stage	Temperature Atmos. °C	Temperature Water °C	Salinity ppt.	pH	D.O. ppm.	CO pp²m.	TotalNo of larvae
26.09.91	0-I	33.0	30.0	5	7.5	5.2	Nil	400
30.09.91	II-III	33.0	30.0	10	7.0	4.9	Nil	360
05.10.91	IV	33.0	29.0	14	7.5	3.0	Nil	300
10.10.91	V-VI	34.0	30.0	14	7.0	4.0	Nil	260
15.10.91	VI-VII	33.0	29.0	14	7.5	3.6	Nil	220
20.10.91	VII-VIII	33.0	29.0	14	7.5	4.9	Nil	180
25.10.91	IX-X	30.0	27.0	14	7.6	3.6	Nil	155
30.10.91	X-XI	24.0	22.0	14	7.5	3.2	Nil	129
05.11.91	XI-PL	29.0	27.0	14	7.4	3.6	Nil	121
09.11.91	PL-XI	28.0	26.0	10	7.5	3.0	Nil	118
14.11.91	Postlarvae	28.5	27.0	0	7.5	4.0	Nil	100

ter taken from the a deep tube well was used. Berried prawns (*M. rosenbergii*) were obtained from the State Fish Farm, Kausalyaganga.

Rearing Procedure

The hatching pool was first got ready with 5 ppt brackishwater, prepared by mixing stored saline water and fresh water. A berried female weighing 80 g. approximately with gray coloured eggs on its abdomen was treated with 2 ppm potassium permanganate. Later, kept in a perforated plastic basket, the prawn was lowered into the hatching pool, with the basket. The pool with the basket was kept under continuous aeration. Just after one day of this release, hatchlings were observed in the pool and the brood prawn along with plastic basket was removed from the hatching pool.

The two rearing pools acquired for the experiments (Tables - 2 and 3) were filled with 5 ppt brackishwater and were stocked with larvae (20 nos/ltr hatchlings, stage-1) collected from the hatching tank. The salinity of the rearing pool was gradually raised to 14 ppt within a period of 5 days. The larvae were fed with egg custard and Artemia nauplii from 2nd day onwards as per the feeding schedule in Table - I.

Egg custard was prepared by mixing 1 gm. of yeast with one hen's egg. The yeast was soaked in 5 ml of warm water and then mixed with egg yolk and albumen and cooked in a water bath. The cooked custard was kept in refrigerator for use as larval diet.

Artemia nauplii were obtained by hatching Indian strain of Artemia cysts in a cylindrical glass jar with 35 ppt sea water under vigorous aeration. The cysts hatched out after 24 to 30 hours and the nauplii were collected as they hatched out, by siphoning them out with a pipe. While feeding, special care was taken to keep some Artemia nauplii in the rearing medium all the time in order to avoid cannibalism among the larvae.

Physico-chemical parameters such as temperature, salinity, pH, DO_2, CO_2 were maintained regularly (Table 2 and 3) in order to provide an optimum range to the rearing medium. The water quality was carefully monitored, siphoning out left-over feed and metabolites through plastic tube and exchanging 50% water daily with water of the same salinity.

The rearing period was 50 days for the larvae to pass through stage I to stage X1 in the two experiments. By this time they were seen to attain post larval (PL) stage (as shown in Table 2 and 3). At this stage they were transferred to one ton capacity plastic fibre pool for their further rearing. The feeding habits of post larvae were different and the rearing practices were more or less comparable with grow-out pond environment.

Discussion

It is seen from the above mentioned two experiments that salinity plays a major role throughout the rearing period and frequent fluctuation of salinity causes

TABLE - 3

Rearing medium 2

Date	Larval stage	Temperature Atmos. °C	Temperature Water °C	Salinity ppt.	pH	D.O. ppm.	CO2 pp²m.	TotalNo of larvae
26.09.91	0-I	33.0	30.0	5	7.0	4.5	Nil	400
30.09.91	II-III	33.0	30.0	10	7.5	4.6	Nil	350
05.10.91	IV	33.0	29.0	14	7.5	5.0	Nil	294
10.10.91	V-VI	34.0	30.0	14	7.5	4.2	Nil	257
15.10.91	VI-VII	33.0	29.0	14	7.0	3.9	Nil	210
20.10.91	VII-VIII	33.0	29.0	14	7.5	4.2	Nil	185
25.10.91	IX-X	30.0	27.0	14	7.0	5.0	Nil	150
30.10.91	X-XI	24.0	22.0	14	7.4	3.9	Nil	123
05.11.91	XI-PL	29.0	27.0	14	7.2	4.5	Nil	120
09.11.91	PL-XI	28.0	26.0	10	7.5	5.0	Nil	115
14.11.91	PostLarvae	28.5	27.0	0	7.0	4.5	Nil	96

moratality. One lesson learnt was that care should be taken to raise the salinity at a gradual rate preferably from 5 ppt upwards to the optimal level and back to freshwater condition in the rearing pools. Temperature too plays a vital role. Temperature in the lower range inhibits moulting, reduces food consumption and prolongs the rearing period : In contrast, temperature in the higher range causes stress to the larvae. A temperature range of 28°C to 31°C was seen to yield good results.

Dissolved oxygen content is automatically regulated by continuous aeration and water exchange but care should be taken to ensure regular aeration, as interruption of aeration causes mass mortality. Proper water management is of crucial importance. There is no way of substituting this with any other practice to achieve good results. Water management helps in reducing the repressive factor caused due to left-over feed and metabolites, increases dissolved oxygen, triggers moulting, reduces rearing period and provides healthier environment for growth of prawn seed in the rearing pools.

Feeding as per requirements also plays a key role. Under-feeding causes cannibalism and stress, making the animals more prone to diseases, while overfeeding pollutes the rearing water in the pools.

Last but not the least is the need for manpower with sound technical background to manage and co-ordinate the activities well and to take immediate remedial measures in case of any detereoration of water conditions or incidence or disease.

The increasing demand for *M. rosenbergii* seeds provides a wide scope for the establishment of hatcheries atleast in the coastal districts of the State. The establishment of hatcheries can provide a boost to "giant freshwater prawn" farming, thereby creating self-employment opportunities. The activity will also contribute to the upgradation of the socio-economic conditions of the poor rural masses.

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Fishery Survey of India's Facility Research Centre at Mumbai

The Fishery Survey of India has recently commenced the construction of its Facility Research Centre at Mumbai. The four storeyed building is being constructed in a half hectare of land at the new Sassoon dock, Colaba. The estimated cost of the Facility Centre is about Rs. 8.9 crores. In view of various heritage buildings and monuments in the vicinity the construction project was to be cleared by the Heritage Committee of the Brihanmumbai Municipal Council. The building which is expected to be completed by October 2002, has inbuilt features to merge with the surrounding heritage buildings and environment. Mrs. S.R. Gangrediwar, Architect and Mr. R.M. Pathare, Sr. Architect of C.P.W.D., Mumbai Circle have designed the building and given the aesthetic features.

The important activities to be accommodated in the building will be four research laboratories, marine engineering workshop, fishing gear design, fabrication and net mending section, conference hall and auditorium, fishery museum, computer and EDP facility, drawing and artist studios, various modern electronic equipment and stores facilities besides having the office facilities for Zonal Director and officers and the staff of Mumbai Base of FSI and Dy. Director General (Fy.), Dy. Director General (Engg.), Director General, other officers and staff of FSI, Headquarters.

MCS Workshop held in Goa

The Department of Animal Husbandry & Dairying, Ministry of Agriculture, Government of India in association with Food & Agriculture Organisation (FAO), rome, organised a National Workshop on Monitoring, Control and Surveillance of Fisheries in Goa from 12th February - 16th February, 2001. The Ministry of Agriculture, (Department of Animal Husbandry & Dairying) authorised its field Institution, Fishery Survey of India to associate and help organise the FAO National Workshop at Goa. The participants included the fishery officers from Maritime States, Department of Animal Husbandry & Dairying, government of India and Central institutions, Coast Guard, FSI, CMFRI, CIFNET and CIFE. In all, 30 participants took part in the Workshop.

The objectives of the Workshop were (i) to study MCS procedures in the context of fisheries management and fisheries law, (ii) to undertake practical experiences in inspection, reporting on prosecution matters (e.g. detection of violations, prosecution, rule of evidence, (iii) to provide understanding on MCS systems, implications and suitability for specific situations (through use of case studies) and (iv) to build up sets of lecture material that can be used in similar regional and national course.

Mr. George Evertt, Sr. Planning Officer, FAO, Ms. Anik, Law Officer, FAO, Rome, Dr. Andrew R. Smith, Fishery Industry Officer, Fishing Technology Service, FAO, Mr. Salehan Bin Lamin, Head, Resources Protection Branch, Department of Fisheries, Malaysia and Mr. Per Erik Bergh, Adviser to the Permanent Secretary, participated.

Central Institute of Fisheries Technology's RECENTLY DEVELOPED COMMERCIALLY VIABLE AND FISHERY-BASED TECHNOLOGIES

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Central Institute of Fisheries Technology (CIFT) is a multidisciplinary research organisation established by the Government of India in 1957. Its administrative control was brought under the Indian Council of Agricultural Research (ICAR) from 1st October 1967. The Institute has been vested with the responsibility of devising suitable technologies for the sustainable exploitation and utilisation of the vast marine fish resources of India. These are to be developed through sustained research in respect of fishing craft and gear suited to regional fishing conditions and also in regard to post-harvest technologies.

Since its inception, the Institute has taken up and successfully completed many studies on various important aspects of fishing and fish processing. As a result of these studies, new technologies have been developed. Existing technologies for the construction and maintenance of fishing craft, and fabrication, operation and maintenance of fishing gear have been improved. Processing and preservation of fish and shellfish, and fabrication of equipment, instruments and accessories for use in fishing and fish processing were the other two areas that received considerable attention. Some of the significant and commercially viable technologies recently developed by the Institute are briefly described here.

FISHING CRAFT

Fuel-efficient fishing vessels: The Institute has developed twelve standard designs of mechanised wooden fishing boats in the size range 7.67 m to 15.24 m during its early days and most of the wooden fishing boats plying in the Indian waters are built to CIFT designs.

A 15.5 m steel fishing vessel, christened 'Sagarkripa', far more fuel efficient than other vessels of its size, has been designed and fabricated by the Institute, and dedicated to the Nation on 17 September, 1999. This vessel has a hydrodynamically efficient hull fitted with advanced propulsion system perfected at CIFT. This vessel has been found to reduce fuel consumption to the extent of 20% compared to similar vessels under identical operational conditions. It is estimated that a vessel of this design will save about 16,000 litres of fuel during one year of operation in comparison to a conventional vessel of the same size. The vessel is fitted with Leyland ALM 412, 125 hp and 2000 rpm engine. The speed of the vessel during free running is 9.5 knots and 4 knots while trawling. For locating fish shoals, the vessel has 50/2000 dual frequency SIMRAD. Fish Finder and GARMIN 128 GPS Navigator. The vessel also features better accommodation standards, higher fish hold volume (30 cu m), increased winch capacity, large fishing deck area and sea-friendly cruising gait. These features help the vessel to achieve higher endurance and to carry out deeper water operations. This vessel is poised to revolutionise the fishing industry by bringing down the operational costs of vessels of this LOA. At present 70% of the operational costs are related to fuel. The present design of CIFT brings down this expense substantially.

FRP Canoes for traditional fishermen: Fiberglass Reinforced Plastic (FRP) is an industrially important construction material. Strength, light weight and long life are the special advantages of this material. As such, it is a convenient and suitable material for building fishing boats, especially those meant for fishing in nearshore waters of the sea and in backwaters. Taking these facts into consideration, CIFT has designed FRP coated fishing canoes for traditional fishermen. Initially four such boats have been built for the Chellanam Village SC/ST Co-operative Society under the Special Component Plan of the Government of India. The CIFT-designed canoe has a length of 5.78 m, breadth of 0.82 m and height of 0.385 m. The cost of construction of each comes to Rs. 22,500/-. It is proposed to construct 17 more such canoes to be handed over to 34 fishermen for fishing operations. Besides, 10 persons have been trained in the construction of such fishing boats.

Aluminium - alloy sheathing for wooden fishing vessels: Most of the coastal fishing vessels constructed and operated in our country are wooden. Unprotected wooden hulls of fishing vessels get damaged by marine borers and fouling organisms. The traditional method of protecting the hull is by providing copper sheathing which is very expensive.

CIFT has recommended cheap aluminium-magnesium alloy for sheathing wooden hulls in the place of costly copper sheathing along with G.I. fastenings, cast iron fittings and aluminium alloy tacks and screws. The alloy is light, resistant to seawater corrosion and cheaper in price. Fouling on metallic surface can be eliminated through the use of a spe-

cific painting schedule recommended by the Institute.

Cathodic protection of fishing boats: Marine metallic structures are constantly subjected to very severe corrosion resulting in heavy maintenance cost. Properly designed cathodic protection system is not only technically feasible but also economically viable. Presently, zinc and ternary aluminium anodes are used for cathodic protection.

A galvanic anode free from mercury has been developed for use in cathodic protection of fishing boats and metallic marine structures. The life of these anodes is three times to that of zinc anodes. As these anodes are free from mercury unlike its commercial counterparts, pollution of the aquatic environment by mercury does not occur.

Specifications were laid down for cathodic protection of steel and metallic sheathed wooden boats, and standards worked out on the quality, quantity and geometrical disposition of the anodes on the hull.

Chemical wood preservatives: Traditional fishing contributes to the major part of fish landings of India. 'Kattamaram' and built-in canoes or boats (such as *navas*) or dug-out canoes are used for traditional fishing. These wooden crafts deteriorate rapidly due to ravages of weather and also because of continuous contact with seawater containing organisms like wood borers which destroy wood. Fishermen use indigenous preservatives like liquid cashewnut shell extract, fish oils etc., to protect their fishing craft. Studies have shown that these preservatives have very little toxic properties. They merely act as water repellents.

Considering the wasteful expenditure incurred by the traditional sector on wood maintenance, CIFT has developed certain chemical wood preservatives viz., arsenic creosote, copper creosote and creoscor. Creosote is a coal tar distillation product. Fortification of creosote with copper or arsenic makes it more toxic and consequently prolongs the efficiency of the preservatives. Fortified creosote not only imparts toxicity to wood against bacteria, fungi and termites but also retards the formation of cracks on the wood due to weathering.

Creoscor is a highly efficient oil-borne wood preservative which is prepared by heating together heavy creosote oil, copper compound and plant resins. The treatment consists of giving two or three liberal coats of copper creosote on all parts of the boat. The hull portion is then coated with creoscor which not only protects the craft but also provides a smooth surface which helps reduce the frictional resistance to motion of the craft in water.

The new treatment costs much less than the traditional treatment.

Fishing Gear

Specialised Gears: The Institute made notable contribution by developing suitable fishing gear for operation from mechanised fishing boats of varying sizes. Designing of nets for operation from traditional craft was also given equal importance. Some of the important types of gear developed are :

1) Long wing trawl; 2) Double rig shrimp trawl; 3) Shrimp trawl for traditional motorised craft; 4) Bulged belly trawl; 5) High opening trawl; 6) Large mesh trawl; 7) High speed demersal trawl; 8) Midwater trawl; 9) Rope trawl; 10) Purse-seine; 11) Mini purse-seine; 12) Large lines and 13) Troll lines.

Gill nets for marine and reservoir fisheries: Gill nets are selective gear, the efficiency of which depends upon the selection of proper thickness or diameter of twine and mesh size. The twine diameter and mesh size for gill nets and trammel nets have been standardised for common marine species like seer, pomfret, hilsa, lobsters, prawns etc., by the institute.

Likewise, gill nets including trammel net and frame net have also been developed and introduced in reservoirs for the capture of catla, rohu, mrigal, catfish and also for catching several miscellaneous fish.

Combination wire ropes for deepsea trawling: Combination wire ropes are specialised wire ropes used as head and foot ropes of heavy demersal and mid water and pelagic trawls. Materials like steel wire and synthetic fibre having divergent qualities when in isolation are combined together to form the combination rope which acquires strength. The synthetic fibre provides insulation for the highly corrosive steel from the hostile marine conditions. India has been importing combination wire ropes from other countries. The indigenous production of combination ropes will help in not only meeting the country's increasing demand but can also be an item of export in the near future.

Otter boards: The Institute has developed a number of designs of otter boards of different shapes and sizes for operation with different sizes of trawl nets from different sizes of vessels. 'V' Form steel otter boards of the as given in Table 1 at next page sizes are recommended for of different OAL trawlers.

Advantages of 'V' form Otter Boards compared to Rectangular flat Wooden Otter Boards

1. They render service for a longer duration (5-6 yrs), when maintained well.
2. They are hydro-dynamically efficient - Hence they enable utilisation of engine power more effectively.
3. They facilitate tiding over bottom obstacles of smaller magnitude and are thus suitable for bottom trawling on somewhat uneven and rocky grounds.
4. They offer less of resistance (drag), there by augmenting speed of trawling without increase in fuel consumption. In other words they contribute to fuel efficiency.
5. They do not plough or dig into mud. They are thus less risk prone and also improve manoeuvring in deepsea

trawling too.

6. They impart an increased measure of efficiency for demersal finfish trawling.
7. Better bottom/ground contact with least lift effect while dragging and no digging in soft bottom.
8. Interchangeable from starboard side to port side and vice versa by effecting slight changes in the fixing of bracket - thus facilitating the reduction in uneven wear of the keel.
9. Relatively cheap.
10. Safe in shooting and hauling, when properly rigged; and
11. Saves precious wood (good quality prime wood).

Turtle excluder device to prevent incidental mortality of marine turtles, during trawling: Marine turtles are endangered species which are protected under Indian Wildlife Protection Act. Incidental catches of marine turtles are known to occur during commercial trawling operations, particularly along the coasts of West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and southern parts of Kerala. Turtle mortality during shrimp trawling is also linked with import embargo on wild-caught shrimp by USA. Turtle Excluder Device (TED) is a special equipment that greatly reduces the incidental death of turtles caught in trawl nets, by facilitating their safe escape during the tow.

Table 1

S.No.	*Length (mm)*	*Breadth (mm)*	*Weight in air (kg)*	*Trawlers OAL (m)*	*B.H.P of engine*
1.	a) 1500	890	125	14-15	125-160
	b) 1500	890	125	15-17.5	165-300
2.	1370	820	70-90	12-14	70-120
3.	1050	620	50-55	10-11	50-65

CIFT has developed a CIFT - TED which is a top exiting, single grid, hard TED of 1000 x 800 mm size, for use by small mechanised trawlers which predominate in Indian waters. Field trials of the CIFT - TED have been carried out off Cochin (Kerala), Visakhapatnam (Andhra Pradesh) and Paradeep (Orissa). Demonstration of fabrication and operation of CIFT-TED was carried out in Orissa, during the mass nesting season of Olive ridley turtles (*Lepidochelys olivacea*) in February, 2001. CIFT-TED permitted 100% escapement of turtles while keeping escapement of shrimp as low as 0.62%. CIFT-TED is now being popularised in maritime states in collaboration with MPEDA and respective State Fisheries Departments.

By-catch reduction devices (BRDs): Incidental catches of non-target species and size groups during trawling operations are an important issue which is linked with conservation of resources and biodiversity. Juveniles and sub-adults of commercially important finfishes form a significant proportion of trawl by-catch. CIFT has conducted investigations with several by-catch reduction devices such as Radial Escapement Device, and Fish Eye and Rigid Single Grid Separator devices, which facilitate the escape of non-target species and juveniles from trawls. Square mesh panels have been developed in order to improve the selectivity of trawl codends and to protect the juveniles.

Square mesh panels: Trawling operations with conventional diamond mesh codend result in mortality of juveniles, as the mesh lumen tend to close under tension, preventing their release. CIFT has developed square mesh panels for trawl codends, incorporating square meshes, which do not close under tension, and facilitate escapement of juveniles and sub-adults.

Improved lobster trap: Spiny lobsters constitute an important item of marine products exported from India fetching foreign exchange for the country. Thousands of traditional fishermen are dependent on this fishery for their livelihood. The traditional traps used by them for exploiting spiny lobsters are made of easily biodegradable vegetable fibres. These traps are crude in shape, less efficient and last only for 2-3 weeks. CIFT has developed a new trap which is 70 x 55 x 40 cm in size and is fabricated out of M.S. rod frame and mounted with 2.5 cm square welded mesh. Corrosion being the greatest drawback for iron materials in seawater, a complete plastic coating is provided to the trap as a measure of preservation which makes the iron material completely impervious to seawater. The trap lasts for 3-4 seasons and is 2.5 times more efficient than the traditional trap in terms of catch and is economically advantageous in the long run. These traps have become highly popular among traditional lobster fishermen of S.W. coast of India.

Studies on baits for lobsters revealed that diesel oil can be successfully used as bait to attract lobsters to the traps.

Fish Processing

Freezing of fish or shellfish: Freezing is one of the important methods for processing food. Preservation of live aquatic animals by freezing depends upon the inhibitory effect of low temperature upon the rate of growth of microbial organisms and the enzymic and biochemical reactions which normally occur in unfrozen foods. CIFT has developed a number of processes for freezing almost all important varieties of fish both marine and freshwater and also shellfish. These include processes for freezing of prawns, squid and cuttlefish, lobster tails, pomfrets, seer, mackerel, sardines, crab, clam, mussel, oyster meat and freshwater fish like major carps, and euryhaline fishes like milk fish.

Filleting and freezing of fish: Fillets are strips of flesh cut parallel to the backbone of the fish. Seer, tuna, mackerel, milkfish, catfish, perch, mullet, threadfin bream, carps, polynemus, shark, eel, leopard fish, coral trout etc. are suitable for filleting and freezing. Frozen fillets can be either exported or sold in domestic

markets.

Filleting can be done by using a filleting machine or by hand. Although filleting machine is preferable for use in a factory, filleting by hand is also economical and can be followed by the industry. The fillets cut from the fish, as per the technique developed, are dipped in 15% brine for 15 to 30 seconds, drained, wrapped individually in polyethylene sheet and frozen at -35 to -40°C. The frozen fillets are packed in cartons and stored at -23°C. Fillets can be frozen as blocks also. Convenient lots are packed in polyethylene lined waxed cartons, sufficient glaze water is added to cover the fillets, frozen and stored.

Canning of fish and Shellfish: Canning is another form of preservation of food materials. Fresh foods normally carry organisms which will cause spoilage if their activity is not either neutralised or contained. The basis of canning process rests on the destruction of these organisms by heat and prevention of the entry of others. Enzymic action will also be restricted by heat treatment. Methods have been developed for canning almost all varieties of fish and shellfish in different forms and media.

Canning of prawn, tuna meat, sardines etc., clam meat, mussel meat, crab meat, edible oyster meat etc., in different media are some of the examples worthy of mention. But due to the prohibitive cost of the cans the canning industry had a major setback and now attempts are being made to introduce alternate methods for the heat processing of fish and fishery products.

Ready to serve fish curry in flexible pouches: Value addition and diversification to satisfy the ever changing and diverse demands from the importing countries as well as urban consumers at home are some of the major challenges faced by the Indian fish processing industry. Value addition is the most talked about word in the fish processing industry these days because of the increased realisation of foreign exchange and high unit value of such products. One such value-added product developed at CIFT is fish curry processed in packed flexible pouches.

The earlier attempts at popularising a ready-to-serve fish curry could not meet with success because of the limitations imposed by the metal containers. Now CIFT has successfully developed a suitable three-layer configuration of flexible pouches which can perform the packaging function equally well as metal cans, and is free from the disadvantages met with them. This is a retortable flexible pouch based on Polyester/Aluminium foil/Cast polypropylene. Now flexible pouches are manufactured in India employing the configuration developed by CIFT and this opened the way for commercialisation of heat processed fish curry packed in flexible pouches. CIFT has standardised the process for the production of fish curry in these pouches using over pressure autoclave and the curry processed in them has remained without any change for over a year at room temperature.

CIFT has a research/pilot model of autoclave with full provisions for monitoring all functions associated with thermal processing of flexible pouches and allied infrastructural facilities.

CIFT can offer state-of-the-art technical consultancy services on heat processing of food products in flexible condition.

Improved method of fish curing: The present method of fish curing is somewhat crude and unhygienic. The fish, after salting, is sun-dried on the open beach or ground by which process it gets contaminated with a lot of sand and mud. Fish cured in this way often shows contamination with red halophilic bacteria and fungus and these products cannot be stored for more than two months.

A method has been standardised for preparing good quality cured fish. In this improved method, the fish, after proper evisceration and cleaning, is salted in a specified way and kept in clean cement containers for about 24 hrs. The salted fish is dipped in saturated brine containing 5% calcium propionate for 2-5 minutes followed by drying. The dried fish is then packed in polyethylene bags for retail marketing and in synthetic woven sacks for bulk marketing. The dried fish so preserved and packed has a shelf life of more than 6 months.

Rack drying of fish: Sun drying is a traditional method of drying fish, either salted or unsalted, depending upon their use. The traditional method of drying is very crude and unhygienic causing quick spoilage of the dried product. CIFT has developed racks for drying fish in a hygienic way. Contamination of fish with sand and other dirt and fish being snatched away by dogs and cats is prevented by drying them on racks.

Any locally available material like bamboo, casuarina, etc., can be used for making the racks. Nylon webbing is used as base of the rack. A rack of two decks can be conveniently used for drying fish. As the fish is dried by strong wind and high temperature in the beach area, the material put on the lower deck also gets dried properly, although drying rate is lower in the initial stage.

Freeze-dried fish products: Freeze-drying has become an accepted method of food preservation and is gaining more of popularity because of its several advantages. In this technique, the material is frozen and the ice is directly converted to vapour (by sublimation) which is removed. The dried, porous material can be well re-hydrated when required. As the moisture content of the freeze dried product is 1-3%, the material has to be packed in air tight containers and stored at ambient temperature. CIFT has developed techniques for processing several freeze-dried fish products including ready-to-serve soup mixes, salads etc.

Dehydrated jelly fish: Jelly fish is a marine species abundant on east and west coasts of India. It has hitherto been unutilised although some of the species are said to be edible. CIFT has now

worked out a suitable method for processing jelly fish. As it is highly susceptible to spoilage under tropical conditions, it has to be processed immediately after catch or kept for a short period in iced condition.

In the process developed, the umbrella portion alone is taken, trimmed, cleaned, washed well and then treated in four solutions of salt and alum of different concentrations and drained till the moisture content is reduced to less than 60%. It is then graded, packed and stored in chilled condition at around 0°C.

Beche-de-mer: *Beche-de-mer* is the commercial name for cured holothurians, commonly known as sea cucumbers. This is a high unit value dry item almost entirely exported. *Beche-de-mer* is known to have an unique place in Chinese diet probably due to its reputation as an aphrodisiac and for treatment of high blood pressure. An improved technique has been evolved for processing *beche-de-mer*. The process involves evisceration of fresh sea cucumbers, cooking in boiling water, drying and packing in gunny bags.

Improved method of preparation of 'masmin/masmin flakes': 'Masmin' is a traditional fish product of Lakshadweep prepared from tuna fish which is an abundant catch of the island. Traditional 'masmin' is crude and poor in quality fetching a very low price. Improvement in quality is sure to fetch the product a better price leading to the betterment of the island's economy.

An improved method has been developed for preparing 'masmin'. The fillets from tuna are cut into steaks, brined, steamed, partially dried, smoked and finally dried followed by packing.

'Masmin' is usually made into shavings or flakes before preparing food dishes. The hardness of the dried product makes the preparation of flakes very difficult. Hence, process has now been developed to convert the cooked product into flakes before smoking and drying.

Fish wafers and soup powder: This is a protein-rich food product prepared from miscellaneous fish. It is prepared out of fish meat, starch powder, salt etc. The cooked meat is first homogenised with water. To this, corn flour, tapioca, starch and salt are added and the whole mass blended for about an hour. The homogenised slurry is then spread uniformly in trays in layers of 3-4 mm thickness and cooked in steam. The cooked material is then cooled and the layers cut into desired shapes and dried. For consumption, it is fried in oil and used as a side dish. Soup powder is another type of protein-rich food formulated by CIFT. Cooked fish meat is mixed with fried onion and other ingredients and ground thoroughly till it becomes a fine paste. The pasty mass is spread in trays, dried and powdered. This powder, in fine form, is mixed thoroughly with the required quantity of milk powder and stored in bottles or in laminated paper bags. The product is a rich source of animal protein and other nutrients and stores well for 16-18 months at room temperature. For consumption, one part of the powder is boiled in 20 parts of water for five minutes.

Battered and breaded products: These items form an important class of value-added fish products. The battering and breading process increases the bulk of the product, thus reducing the cost element. The basic fish products prepared after preliminary processing are battered and breaded to obtain the final products which can be stored in frozen condition for future use. CIFT has developed methods for preparation of several types of battered and breaded fish/shellfish products. Important ones among them are fish fingers, fish sticks, fish cutlets, fish patties (burgers), prawn products like peeled and deveined, cooked and peeled, pan tail (butterfly) and round tail-on, squid rings, stuffed squids, mussel, clam and oyster, cuttlefish fillets, fish fillets etc.

Pickles from fish and shellfish: Fish pickles have got wide acceptance in the internal markets. They are likely to have regular foreign markets particularly in Gulf countries.

The meat from fish/shellfish is prepared as per specific methods, mixed with salt, kept aside for some time, fried and mixed with lightly fried chilli powder, turmeric, mustard seed, garlic and ginger. Afte cooling, vinegar is added and the product is stored in clean bottles. Pickle prepared by this method keeps well for 8-10 months. Pickles can be prepared from fish, prawns, mussel meat, clam meat, oyster meat etc.

Industrial Products

Chitin and Chitosan from prawn shell waste: More than 1,00,000 t of prawn and other crustacean shell waste is available annually from prawn processing centres in India. This is not properly utilised at present. CIFT has developed a process for preparation of chitin from prawn shell waste. Chitin can be incorporated in the diet for broiler chicks. The diet with chitin was found to improve the feed efficiency, resulting in about 10-12% weight gain in the birds compared to a chitin-free diet. Use of chitin for the production of glucosamine hydrochloride which finds application in antibiotics and baby food formulations is already known. Chitin is also a raw material for preparation of chitosan. Chitosan is a valuable chemical substance finding use in several fields. Process has been developed for preparing chitosan from crustacean shell wastes.

Chitosan can be used as sizing material for textiles. It can be used as a water/wine clarifying agent and also in the preparation of cosmetics, pharmaceuticals etc. Recent studies have shown the effectiveness of chitosan in the form of microfined powder, impregnated gauze and film for treatment of chronic wounds and external ulcers and to arrest/minimise bleeding in neurosurgery. Chitosan film can also be used as artificial skin and kidney membrane, and as contact lens. Incorporation of chitosan during mixing and homogenisation of shrimp and fish feeds for pelletisation and granulation of the

feed imparts very good water stability to the feed without the use of sophisticated machinery.

Fish feed: With the advancement of scientific fish/prawn farming in India, need for good quality feed is felt. The indigenous feed used by farmers does not meet the nutritional requirements of the fish. Other types of feed available in the market are very costly. Therefore, formulations have been worked out at CIFT for preparation of fish/prawn feed at reasonable cost by incorporating miscellaneous fish and fishery wastes like prawn shell and squilla, groundnut cake, groundnut oil, starch and salt mixture in specified proportion. This feed can be prepared by the skilled farmers with simple facilities.

Surgical sutures: Absorbable surgical sutures are an essential requirement for wound healing after a surgery. Of the various materials tried, catgut is found most acceptable and is the most popular material now used all over the world. But it has its own drawbacks and is also very costly.

CIFT has been examining the possibility of using processed fish guts as surgical sutures for providing a relatively cheaper suture material and at the same time ensuring utilisation of the presently wasted fish guts. The absorbable extra fine sutures are prepared from the fish gut collagen by cross linking and polymer coating and has been found suitable for eye and other microsurgery. It is comparable to the commercial product in its physical properties like thickness, uniformity, breaking strength etc., and is free from abnormal toxicity and tissue reactions.

Collagen-chitin film: This film is prepared from collagen and chitosan obtained from fishery wastes and can be used as artificial skin. It is used for covering wounds/burns to prevent moisture loss and microbial invasion.

Purified air bladder is partially solublised in hydrophilic solvent. Viscous suspension obtained is spread on clean glass surface and evaporated to give thin film of collagen. Reformed chitin matrix is deposited on this exposed surface to give strengthened collagen film.

Shark cartilage: The skeleton of shark is made of cartilaginous bones, which is about 10-15% of the body weight. Until recently, only very small quantity of these bones was made use of, that too from small sharks, for making buttons and necklaces. This cartilage is rich in chondriotin sulphate which has got application in medicine for treatment of arterosclerosis, blood vessel thrombosis and also to prevent infections. Now there is very good demand from Europe, USA and Australia for processed shark bones.

The head and vertebral column of the sharks collected are to be processed to a presentable and stable form before export. A procedure has been developed for the processing of the cartilage into a clean, dry, white, attractive material without any characteristic smell. The products are well accepted by the overseas buyers.

Squalene from shark liver oil: Squalene is a hydrocarbon extracted from the liver oil of shark by fractional distillation under vacuum. An improved method has been developed to extract squalene from shark live oil.

Squalene is used in the preparation of seroid hormones, treatment of wounds and liver diseases and as anti-cancer agent and bactericide.

Hydogenated squalene (squalane) is used in the preparation of cosmetics, perfumes and aromatics and as anti-aging agent and lubricant in finishing silk and wool.

Shark fin rays: Shark fin rays are valuable products of export from India. Formerly, only shark fins were being exported. But now, even fin rays are exported. CIFT has developed a technique for extracting rays from shark fins.

Thr dried fins are soaked in dilute acetic acid for sufficient time to get the muscle and skin softened. The skin is then scraped off and the fins further treated with dilute acetic acid when separation of the rays in clusters becomes easy. The rays are then dried and packed in polyethylene bags.

The rays are utilised in the preparation of soup in many foreign countries. There is good internal demand also for shark fin rays especially in major hotels.

Isinglass: Fish maws are carefully washed and dried air bladder of fish. Air bladders are taken mainly from dara fish, jew fish, cat fish, eels etc. Fish maws are mainly used for making isinglass. Fresh air bladder is taken out, the internal membrane is removed, and the bladder is well cleaned and dried. Fish maws have got great demand in several foreign markets.

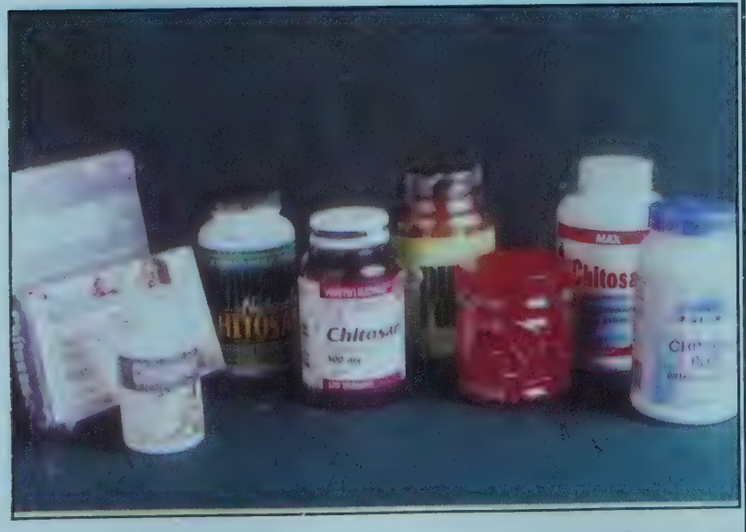
Concentrated PUFA from fish oil: Polyunsaturated fatty acids (PUFA) have therapeutic value as they have the power to lower the cholesterol level. A method has been worked out and perfected by the Institute to increase the PUFA content in the oil by suitable methods of concentration. The technology is ready for transfer.

Agar and agarose from seaweed: Sea weeds are important organic renewable resources of the sea, used for a variety of purposes like preparation of agar, agarose, carrageenin etc.

CIFT has developed a process for producing good quality agar with high gel strength by alkali treatment instead of the conventional acid treatment method. Dried sea weeds are soaked in water, agitated to remove foreign particles, drained, treated with sodium carbonate solution and heated. It is then washed repeatedly to free it of the alkali and the agar extracted by boiling with dilute hydrochloric acid. The extracted gel is frozen and then thawed and the thaw water drained off. The gel obtained is bleached, washed with water, drained and dried. It is then powdered and stored in plastic bags.

Sagar Krupa - 15.5 m OAL fuel efficient trawler designed by CIFT.

Holothurians : Raw Material for making *Beche de mer*



Chitosan manufactured from shrimp and prawn head.

Architect's Model of Fishery Survey of India's Headquarters Building now coming up at Sassoon Dock, Mumbai

Trawler workers agitate against Joint ventures

The Trawler Workers Welfare Association, Visakhapatnam has sought immediate cancellation of all licences issued to joint venture to deep-sea fishing companies for operation in the Indian waters and conducted a rally on May 2.

The Association organised a dharna in which the National Fisheries Forum convener, Fr. Thomas Kochery, and the World Fisheries Forum convener, Mr. Harekrishna Debnath, participated.

Mr. T.K. Rahman, Secretary, and Mr. M.A. Latheef, president of the Forum are reported to have said that the other main demands were making all east coast States to observe the conservation period for proper growth of fish at sea and making diesel and kerosene available at subsidised prices.

The trawler workers threatened an all-India strike, if the Government do not pay heed to their demands.

Short course on Digital imaging and Graphics

A short course on Digital Imaging and Graphics first of its kind in ICAR was organised by CIFE, Mumbai from 26 February to 3 March 2001. The programme was inaugurated by Dr. S.D. Tripathi, Ex Director of CIFE. A total of 11 participants attended the training programme. The course covered Corel draw and Photoshop, besides graphic design concepts, digital photography and preperation of exhibition materials. The exhibition of the assignments of the participants was put up on the last day. It was highly appreciated by one and all. Dr. A.G. Sawant, Chairman ASRB, the Chief Guest of the valedictory function, distributed the certificates the participants.

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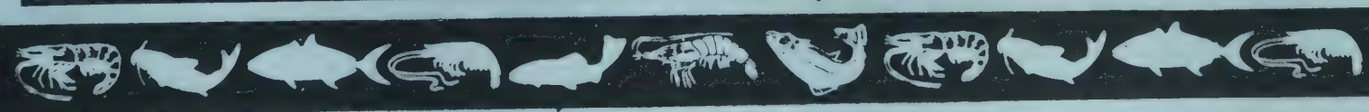

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Social Infrastructure Facilities in Coastal Fishing Villages of Kerala : Present Status

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The progress made by Kerala in the field of social development has been widely acclaimed. In terms of development indices such as general literacy rate, infant morality rate, birth rate, life expectancy etc., the State is on par even with those of many developed countries. Despite being economically backward with regard to GNP growth, the State has given topmost priority to the development of basic needs of people. As a result, the State came to occupy a unique position in the scenario of social development in the country. This has been achieved without effecting any major restructuring of the society. This model of development known as 'Kerala development model.'

The lack of basic social infrastructure facilities coupled with poverty and exploitation have been instrumental for the general backwardness of the fisher community. In order to uplift the fisherfolk, the State government has been implementing various schemes for the creation of social infrastructure facilities right from the third Five Year Plan onwards.

Housing: Even a casual observer of fishing villages in Kerala is wonderstruck by the deplorable living conditions of coastal fishing communities. Compelled by the 'way of life', fishermen live very close to the sea in small closely built huts making the village look like an urban slum. Often these houses are prone to the threats of vagaries of nature. The assignment of title deeds to the fishermen for the land beyond the cadastral survey is a problem to be solved.

To solve the acute housing problem prevalent among fishermen various schemes were undertaken by the State government in the fishing villages as early as 1960. The 'Housing and Colonisation programme' was the first scheme launched by the State government on a land identified by the Department of Fisheries. This was followed by 'Housing Grant Scheme', implemented for fishermen with limited land holdings. The details of the housing schemes implemented prior to 1980 are given above and in following pages.

Sl.No	*Name of the scheme*	*No. of houses sanctioned*	*No. of houses completed*
1.	Housing and Colonisation	1611	161
2.	Fisheries Grant Scheme	4010	4010
3.	Rehabilitation Scheme	452	452
	Total	**6073**	**6073**

	Stage I	*II*	*III*	*IV*	*Total*
No. of houses targeted	10,000	10,000	10,000	10,000	40,000
No. of houses completed	10,000	10,000	10,000	3,400	33,400
Expenditure (Rs. crores)	4.00	5.00	6.00	4.76	19.76

The HUDCO-assisted housing scheme with loan and subsidy component was taken up for implementation first by Kerala Fishermen Welfare Corporation and later by Matsyafed. Due to various reasons the scheme lost its attraction and hence discontinued during 1999-2000. A total of 33,400 houses were constructed during 1985-96, the details of which are given in the following Tables.

At present the Department of Fisheries is implementing housing programmes with the assistance of National Fishermen Welfare Fund Scheme and Tenth Finance Commission. An amount of Rs.35,000/- per house is granted to the fishermen. The beneficiaries are selected by a District Level Beneficiary Committee. The construction of houses is undertaken by the beneficiaries themselves so as to avoid exploitation by contractors. So far, a total of more than 20,600 houses are sanctioned, against which construction of more than 14200 houses has been completed. The details of implementation are furnished in the Tables.

The State Govt. has paid adequate attention to construct houses for rehabilitating fishermen who lost their huts for various reasons the details of which are as follows:

Vizhinjam rehabilitation scheme was implemented by availing finance from HUDCO and NFWF. An amount of Rs.69.74 lakhs was granted for Thankassery Rehabilitation Scheme. In order to rehabilitate the fishermen at Pozhiyoor who are the victims of liquor tragedy, Rs.70 lakhs was granted and 200 houses were constructed.

An abstract statement of various housing schemes so far undertaken in fisheries sector are given on the next page.

In addition to the Central and State sponsored housing schemes, local bodies have also constructed substantial number of houses for fishermen, the details of which are not available. Trissur and Kannur districts have already attained saturation level in housing sector. A total housing programme is going to be implemented in Trivandrum, Kollam and Thrissur districts with the initiative of local bodies. In the wake of decentralised planning, housing for all fishermen is not a distant dream.

Fishery Roads : Roads form a vital link in the infrastructure development for mar-

HOUSING FOR FISHERMEN			
Year	*Allotted Amount (Rs. lakhs)*	*No. of allotted houses*	*No. of completed houses*
a) Housing under National Fishermen Welfare Scheme			
1987-88	10.00	390	195
1988-89	27.462	300	257
1989-90	35.974	-	80
1990-91	-	300	179
1991-92	22.00	65	65
1992-93	103.58	261	261
1993-94	105.00	357	357
1994-95	218.85	792	792
1995-96	348.19	934	934
1996-97	348.9	1199	1170
1997-98	600.00	1713	1509
1998-99	600.00	1717	1447
1999-00	599.5	1719	918
1999-01	800.00	2284	-
Total	**3833.456**	**12031**	**8164**
b) Housing under Xth Finance Commission			
1996-97	-	-	-
1997-98	750	2142	1969
1998-99	899.85	2571	2354
1999-00	1349.9	3587	1735
Total	**2999.75**	**8570**	**6058**

constructed with the grant obtained from Xth Finance Commission. An amount of Rs.13 crores was earmarked for the programme. The scheme is implemented initially by PWD and later by HED. The construction of 186 roads was undertaken against which 142 roads have been completed and 44 roads are now under various stages of construction. The details of implementation of fisheries road scheme are given in the Table on the next page.

Scheme	No. of houses Completed	No. of houses to be completed
Vizhinjam	867	164
Thankassery	100	124
Pozhiyoor	200	-
Total	1167	288

The creation of fisheries road system interlinking the fishing villages with the markets and the export centres will facilitate hygienic handling and quick transport of fish. However, no provision is made for maintenance of roads constructed under various schemes utilising fisheries funds. As such, this responsibility is to be shouldered by the local bodies and adequate funds are to be provided for the annual maintenance of roads.

Sl.No.	*Name of the scheme*	*No. of houses completed*	*No. of houses sanctioned*	*Amount expanded (Rs. crore)*
1.	Housing and colonisation	1611	1611	0.24
2.	Fisheries grant scheme	4010	4010	N.A
3.	Houses under HUDCO scheme	33,400	40,000	19.76
4.	Houses under NFWF	8164	12031	38.33
5.	Houses under Xth Finance Commission	6058	8570	29.99
	Total	53243	66222	88.32

keting and transport of fish. With this aim in view, Department of Fisheries has constructed more than 90 roads with a total length of about 300 km through Public Works Department since 1965. In addition to these roads 265 km of roads were

Drinking water supply: One of the reasons for the poor health condition in fishing villages is inadequate supply of safe drinking water. Wells and public taps are the main source of water in the villages. However, only in 17% of the villages have wells exclusively used for drinking water. 88% of the villages have public water taps. In 70% of the fishing villages some of the houses have direct tap water supply. However scarcity of safe drinking water continues to be a major problem in fishing villages which has to be addressed with the intervention of local self governmental set up.

At present the State Government is implementing a drinking water scheme exclusively for fishing villages utilising the grant from the Xth finance commission. The target is to cover 70 fishing villages. The outlay earmarked for the programme is Rs. 7 crores at the rate of Rs.10 lakhs per village. The responsibility of implementing the scheme is vested with HED and KWA. Out of 70 schemes 23 schemes have already completed and the remaining schemes are progressing.

Sanitation: Fishermen's settlements totally lack latrine facilities. Apart from sanitation, fishermen, particularly women, are denied privacy in this respect. Therefore any coastal housing programme meant for fishermen should invariably consider provision for toilets with water supply arrangements. Adequate attention is also to be paid for sewage disposal. Matsyafed had implemented schemes to provide latrines to fisher households with the assistance from HUDCO. The State Government is implementing a scheme through local bodies for providing 'Danida model' latrines to fisher households since 1997-98. The cost of each unit is Rs.2,500/-. 9,200 number of fisher households will be benefited out of the scheme. The details of implementation are furnished on the next page:

Dispensaries : While health facilities are not scarce in fishing villages, wider coverage and extension of health facilities

Fishery Roads

Sl.No	Name of District	No. of works taken up	No. of works completed-	No. of works in progress
1.	Trivandrum	30	26	4
2.	Kollam	25	15	10
3.	Alappuzha	14	10	4
4.	Kottayam	10	8	2
5.	Ernakulam	21	14	7
6.	Thrissur	14	8	6
7.	Malappuram	13	10	3
8.	Kozhikode	13	13	Nil
9.	Kannur	26	22	4
10.	Kasargode	20	16	4
	Total	186	142	44

Sanitation

Year	Amount sanctioined (Rs. lakhs)	No. of latrines sanctioned	No. of latrines constructed
1997-98	30	1200	1108
1998-99	60	2400	1472
1999-2000	60	2400	427
2000-2001	80	3200	Nil
Total	230	9200	3007

are needed in fishing villages. More than curative facilities, there has to be emphasis on preventive measures. The State Government have so far sanctioned 37 fisheries dispensaries to be established in various coastal villages. The scheme was proposed in such a way that the land required should be provided by the local bodies free of cost. The building for the dispensary would be constructed by the Department of Fisheries and handed over to the Public Health Department for running the dispensaries with the necessary personnel and equipments. Under the scheme 27 buildings for dispensaries have been constructed. A statement showing the present status of dispensaries is given alongside and on the next page.

Fisheries dispensaries are functioning fairly well and are frequented by a large number of fishermen. In many cases the Public Health Department has upgraded the dispensaries to PHCs and augmented facilities.

Guide Lights: The State Government had initiated a scheme for the construction of 16 guide lights during 1960 through PWD. Most of the guide lights functioned only for a short period due to defective design. Hence based on a new type of design using angle iron frame, ten more guide lights were sanctioned. It is seen that even the new type of design is not satisfactory for the coastal conditions. The structures will be durable only when they are painted properly and maintained regularly. As guide lights are very useful to fishermen to return to their destination during night hours, this facility deserves be provided as part of the landing centres proposed along the coast.

Fish Markets : The State Government is implementing a scheme for the renovation of retail fish markets owned by the local bodies. The scheme envisages provision for potable water, drainage, selling platforms etc. An amount of Rs. 4 lakhs per market is granted to each local body for implementing the scheme. The details of release of funds and number of markets sanctioned are furnished below.

The construction of eight markets is completed and another eight markets are under various stages of construction. In the inland sector the construction of markets at Vaikkom, Perambra, Nedumangadu and Kundara was taken up and the construction work at Vaikom and Peramba markets was completed. The construction of inland markets at Nedumangadu

Dispensaries

Sl.No	District	Condition of Building	Whether started functioning
1	2	3	4
	THIRUVANANTHAPURAM		
1.	Edava	Permanent	Yes
2.	Thiruvallom	Temporary	Yes
3.	Puthukurichi	Permanent	Yes
	KOLLAM		
4.	Paravoor	Permanent	Yes
5.	Alappad	Permanent	Yes
	ALAPPUZHA		
6.	Thottappally	Permanent	Yes
7.	Pallithode	Permanent	Yes
8.	Arattupuzha	work started	No
9.	Pallana	not started	No
	ERNAKULAM		
10.	Nayarambalam	Permanent	Yes
11.	Puthuvaipu	Temporary	Yes
12.	Chellanam	Permanent	Yes
	THRISSUR		
13.	Karimpuram	Permanent	Yes
4.	Battika	Permanent	Yes
15.	Punnayoor	Permanent	Yes
16.	Andathode	Permanent	Yes
17.	Edavilangu	Permanent	Yes
18.	Koolimuttom	Permanent	Yes
	MALAPPURAM		
19.	Vallikunnu	Permanent	Yes

... contd

20.	Veliyamcode	Permanent	Yes
21.	Koottayi	Permanent	Yes
22.	Parappanangadi	Not started	No
23.	Thevarkadappuram	Permanent	Yes
	KOZHIKODE		
24.	Kottakkal	Permanent	Yes
25.	Madappally	Permanent	Yes
26.	Badagara	Temporary	Yes
27.	Ezhukudikkal	Not started	No
28.	Puthiyappa	Not started	No
29.	Ayanikkad	Not started	No
	KANNUR		
30.	Ettikulam	Permanent	Yes
31.	Muzhuppilangadu	Permanent	Yes
32.	Andoor	Temporary	Yes
	KASARAGODE		
33.	Ajanoor	Permanent	Yes
34.	Arikkady	Permanent	Yes
35.	Thaikadappuram	Permanent	Yes
36.	Mavilakadappuram	Permanent	Yes
37.	Valiaparamba	Permanent	Yes

Year	*Amount Allotted (Rs. lakhs)*	*No. of markets sanctioned*
1998-1999	60	15
1999-2000	70	18
2000-2001	100	25
Total	230	58

and Kundara is progressing.

Fisheries Schools : The fisher population have not yet reached the general literacy levels in Kerala. This is considered to be one of the reasons for the general backwardness of fisher community. The dropouts of fisher children from primary school level is very high. This is mainly due to lack of facilities for study, inadequate parental care and encouragement. About 92% of fisheries have schools right in the village. However, in most of the villages, fisher children do not attend their classes regularly. They join their parents / other elders regularly at the landing centers to assist them in fishing activities rather than going to schools.

Having recognised the importance of education in emancipating fishermen from the clutches of poverty and exploitation, during the First Five Year Plan period itself the State Government started 'fisheries schools' under the Department of Fisheries. While admission to these schools was open to all students, the children belonging to fisher community were given certain concessions such as free books etc. Teaching in all classes was done with specific attention to fishery science. In 1965 the administrative control of 'fisheries schools' under Department of Fisheries was handed over to the Department of General Education. Decades ago, Late Sir Frederick Nicholson, the founder of fishermen's co-operatives in India, had stressed the need for starting special schools for fisher children. Department of Fisheries started Regional Fisheries Technical High Schools (RFTHS) in various districts exclusively meant for fisher children. The details in this regard are furnished in the Table below.

Only such of the children who have passed 7th standard are admitted in these schools and given an opportunity to study from 8th standard onwards. These schools are provided with free boarding and lodging facilities. Boarders are given free tuition during the early morning and late evening hours. Fisheries science is taught as a special subject over and above syllabus prescribed for high school students.

Though started with limited facilities, new two-storeyed buildings for the school and hostel were constructed at Arthungal in Alappuzha district, Karunagappally in Kollam district and at Koyilandy in Kozhikode district. For the construction of new school building for RFTHS, Valiyathura in Trivandrum district an amount of Rs.90 lakhs is sanctioned. Steps are being taken for the construction of new buildings for the schools at Azheekkal in Kannur district and Beypore in Kozhikode district. A new school for girls will be started at Kasargod during this year.

In order to improve the standard of education in residential fisheries schools, laboratory, library and museum facilities and provided. Action is taken for the purchase of equipments for sports and games. Each school is provided with TV and VCR so that the general awareness of students can be improved. Quite a few residential fisheries schools consistently produce excellent examination results. This is an indication that when proper environment and needed facilities for learning are provided students from fisher community are as good as their counterparts in any other community.

	Name of School and District	*Year of commencement*	*Location*	*Strength in High School Classes*
1	RFTHS, Trivandrum	1968	Valiyathura	92
2.	RFTHS, Kollam	1984	Karunagappally	76
3.	RFTHS, Alappuzha	1984	Arthungal	90
4.	RFTHS, Ernakulam	1968	Thevara	92
5.	RFTHS, Thrissur	1981	Chavakkad	70
6.	RFTHS, Malappuram	1981	Tanur	25
7.	RFTHS, Kozhikode (Boys)	1981	Beypore	30
8.	RFTHS, Kozhikode (Girls)	1994	Koyilandy	65
9.	RFTHS, Kannur	1968	Azheekal	110

Recommendations

1. Design of houses in fishing villages should be appropriate and in consonance with the socio-economic, physical and climatic conditions of the locality. Housing schemes are to be invariably integrated with facilities for toilets, drinking water and power connection.
2. More link roads are to be constructed connecting fishing villages with the main coastal roads so that accessibility can be increased for the benefit of fishermen.
3. Guide lights may be provided as part

of landing centres to be established in fishing villages.

4. Residential Regional Fisheries Technical Schools are to be established in all marine districts from upper primary level onwards.

5. Basic minimum facilities such as roofed stalls, toilets, dressing rooms, drinking water points etc are to be provided in fish markets located within the close range of fishing villages.

6. Community halls are to be established in all fishing villages so that gramasabhas etc can be convened and community-oriented activities can be organised.

7. Adequate supply of safe drinking water is to ensured either through the construction of wells or through extension of pipelines. Stand pipes and wells are to be provided with platforms and drains.

8. Libraries and anganvadies are to be established in all fishing vilages.

9. Self contained common latrine units (pay and use type) with water facilities are to be provided in all landing centres.

Multifilament Net Plant of SAFA Marine Industries Ltd inaugurated at Balasore, Orissa

On the auspicious day of Saraswati Puja on the 29th January, 2001, Orissa's Minister of Industries Hon'ble Kanaka Vardhan Singh Deo inaugurated the expansion project of SAFA MARINE INDUSTRIES LTD. at the company's factory premises at Biruan, Sergarh, Balasore. The Norwegian Ambassador in India, His Excellency Truls Hanevold graced the function and the M.P. of Balasore Mr. M.A. Kharabela Swain of Balasore presided over the inauguration function as Guest of Honour.

SAFA MARINE INDUSTRIES LTD. is a Joint Venture Company of REFA HOLDING AS, Norway and SADHOBA MARINE PVT. LTD., India with equal equity participation by the two partners. The Joint Venture Company was registered in 1995 with the objective to manufacture fishing requisites mainly for export, in accordance with the Joint Venture Agreement signed between Mr. Roger Konradsen of REFA HOLDING AS and Capt. Haren Mahapatra of SADHOBA MARINE PVT. LTD.. The Industrial Promotion and Investment Corporation of Orissa Ltd. (IPICOL) also provided part of equity for the establishment of the Company.

A handsome soft term loan was provided by the Norwegian Agency for Development Co-operation (NORAD) for the establishment of the factory by the Joint Venture Company. The State Bank of India also came forward to provide supplementary term loan to meet remaining requirements of funds for the project. With the equity provided by the promoters and term loans received from the institutions, the factory equipped with modern imported and indigenous machineries for manufacture of fishing nets was completed in December, 1999. Working Capital was availed from the State Bank of India and the Company went into commercial production from 11th February, 1997.

Picture taken after the inaugural function, with hon. Kanak Vardhan Singh Deo, H.E. Truls Hanevold, Capt. Hiren Mahapatra, Managing Director of the company and others.

The commercial production of the factory was inaugurated by the then Chief Minister of Orissa Mr. J.B. Pattanaik in the presence of the then Norwegian Ambassador in India Mr. Arne Walther.

The first container load of fishnets manufactured by the Company was exported to Norway from Calcutta Port on 09.05.97. This export heralded a new era for export of fishing nets from India to Europe. The Company has been exporting fishing nets to Europe regularly since then.

While concentrating on consolidation and quality improvement of the manufactured product, the Company has also undertaken the expansion in phases. The first phase of expansion comprised the addition of an imported extruder for manufacture of monofilament yarn from Nylon-6 Granule. The extruder has been installed and commissioned in January, 2000. With the commissioning of this extruder, import of nylon monofilament yarn for manufacturing of monofilament nets has become no longer necessary. This expansion was financed from a loan received from DEN NORSKE BANK of Norway guaranteed jointly by NORAD & REFA HOLDING AS.

Now, with the advice of the Norwegian Partners, the Company has gone into a limited scale manufacture and export of multifilament nets by providing facilities for proceessing and dyeing of such nets in the existing factory. The multifilament yarn is still being imported.

Addition of a separate factory building with machineries for twisting of multifilament twine from basic yarn, weaving of nets, and processing and dyeing the same has been planned in the 2nd phase of expansion for full scale production of Multifilament Nets. DEN NORSKE BANK of Norway has also pro-

vided loan for this expansion. The new factory building with some machineries required for production is now ready for inauguration.

With the completion of the 2nd expansion, SAFA MARINE INDUSTRIES LTD. shall be able to increase its exports to about Rs. ten crores within two years.

The establishment of the Company's factory and various phases of its expansion has been possible with term loans extended by NORAD and loans extended by DEN NORSKE BANK provided under the guarantees of NORAD & REFA AS. The Norwegian Embassy in New Delhi has evinced keen interest in the growth and successful operation of the Indo Norwegian Joint Venture Company. But for their support and help and technical guidance of REFA the growth achieved would not have been possible.

The Company now looks forward to further exciting phases of expansion to manufacture fishing ropes, mono lines etc. to offer a complete range of fishing implements to the fishing industry. Manufacture of fishing nets of a high quality involves special skills and is labour intensive. The process needs careful and rigorous monitoring to assure quality. Being a pioneering project, obtaining the required technology from different countries has been extremely challenging for the company and members.

Salient Features

a) First Indo-Norwegian Joint Venture Project in Orissa.

b) First Indo-Norwegian Fishing Net Project in India.

c) First Indo-Norwegian Project in India to export Nylon Gill Nets & processed Nylon Multi Net.

The company has employed over seventy ladies, besides some destitutes & handicapped members.

The main impediments facing the company are as under :

a) Poor quality of power supply which hampers productivity and quality severely.

b) Procedural delay with the DGFT & Customs, and

c) Poor work culture.

China and other South Asian Countries are dumping finished materials in India at a rate cheaper than our raw material cost. Despite this, it is hoped that the above impediments will be removed soon and India will emerge as a World Power, as competitive as the rest of the world. The company looks forward to brighter days of becoming a world leader in this line - in remembrance of the ancient Sadhobas who conquered the Eastern Archipelago in pursuit of wealth, fame and adventure.

Potential of Ornamental Fish Trade

The National Bank for Agriculture and Rural Development (Nabard) has identified enormous potential in the breeding and trading of ornamental fish, especially in West Bengal.

According to a report prepared by Nabard, the global trade in ornamental fish is over US $5 billion and its annual growth rate is more than six per cent. It is likely to grow to a level of US $7 billion. The share of India in the global ornamental fish market continues to be poor with just 0.007% share despite rich faunistic resources'. It is felt that there are possiblities to raise it to 0.1 per cent in next five years accounting for exports worth Rs. 30.45 crores as against the present level of Rs. 1.58 crores, it it stated.

West Bengal's share in the national trade in ornamental fishes is an overwhelming 90 per cent, but this level may not be sustained as most of the trade is based on capture in the eastern and north-eastern States. There are about 500 units in the districts of Howrah, Hooghly, South 24 Parganas and North 24 Parganas.

"In order to sustain the growth, it is absolutely necessary at this point to shift the focus from capture-based to culture-based development with emphasis on scientific principles and adherence to quality norms and thereby ensuring genetic and morphometric characters of the species and breeds," the report of NABARD has said. It is learnt that pointed out. Nabard has already prepared model schemes for entrepreneurs. The West Bengal Government and Marine Products Export Development Authority have taken up certain initiatives to foster ornamental fish trade.

Singapore is the largest exporter of ornamental fish followed by Hong Kong, Malaysia, Thailand, Philippines, Sri Lanka, Taiwan, Indonesia and India. The largest importer is the US, followed by Europe and Japan. The emerging markets are China and South Africa.

DR. PADHI IS IN OTTAWA

Dr. B.K. Padhi, the author of the book '***Applied* Fish Genetics**' is at Ottawa Health Research Institute now to participate in the Zebrafish genome project. It would be of much interest to readers to note that after the availability of complete genome sequence of man, scientists would be interested to the function of each gene. It should be eminded that a good number of genes start functioning in the developing embryo.

Currently, Zebrafish is being used as a hot vertebrate model for gene function and gene regulation study. Thus, by participating in this project Dr Padhi will equip himself with new technolgy and in turn will contribute to the health science. Dr. Padhi believes that it is a part of his long term goal to enhance his ability to develop innovative genetic technology for aquaculture and fisheries. He may contacted at his

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CIBA - Developed Indigenous Shrimp Feed Technology

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Shrimp farming has shown phenomenal growth during the last decade and has emerged as a commercial enterprise. Feed being a major input, it has become a focal point in shrimp aquaculture. Feed technology has not developed in India at the same pace as the growth of penaeid shrimp culture. Both imported as well as indigenous feeds are used in the country. While the imported feeds are expensive despite duty reliefs given by the government, the indigenous feed industry is producing supplementary feeds using only emperical formulations. It is in this context, the Central Institute of Brackishwater Aquaculture (CIBA) has taken up mission-mode research projects on nutritional studies of candidate species namely, *Penaeus monodon* and *P. indicus*, identification and evaluation of suitable feed materials, formulation of balanced feeds and development of processing and production technology using indigenously available raw materials and machinery. CIBA has developed shrimp feed technology for processing and production of different grades (Starter, Grower and Finisher) of pellet feeds for improved extensive and semi-intensive culture of both tiger and Indian white shrimp. The feeds were tested in yard experiments and also in field tests in grow-out ponds, which gave good growth and feed conversion ratio (FCR). The indigenous shrimp feed technology developed at this Institute would help in producing good quality and cost-effective feeds for shrimp culture in the country.

Nutritional Requirements of Penaeid Shrimp

Understanding the nutritional requirements of candidate species of shrimp is essential before attempting formulation of balanced feeds. Shrimp feeds should have adequate energy for body maintenance and growth. It is contributed by the three major nutrients namely, proteins, fat and carbohydrate. The feeds should have vitamins and minerals to meet their deficiencies. Shrimps are attracted to feed through chemoreceptors, which are distributed all over their body. Substances like free aminoacids present in feed act as attractants to shrimp. Such attractants and flavours are needed in shrimp feed for quick consumption and effective utilization of feed.

Table 1: Dietary requirements of *Penaeus monodon* and *P. indicus*

Nutrient	*Penaeus monodon*	*Penaeus indicus*
Protein % (with good essential amino acid profile)	35-46	30–42
Lipid rich in PUFA %	3.5-8.0	6.0-9.0
Lecithin %	0.1-2.0	0.5-2.0
Cholesterol %	0.5	0.5
Total energy (kcal/kg)	2800-4300	3500–4000
Vitamin mixture % (Vitamin B group and C and other vitamins)	0.5-1.0	0.5-1.0
Mineral mixture % (Calcium, Phosphorus, Potassium, magenesium copper, zinc, selenium etc.)	2.0-3.0	2.0-3.0

A data base has been developed on the dietary requirements of tiger shrimp *(penaeus monodon)* and Indian white shrimp *(Penaeus indicus)* which are summarised in Table 1.

Feed Raw Materials

Identification and selection of raw materials is essential for formulating successful feeds. Animal protein is indispensable for balancing the essential amino-acids in shrimp feeds. The proportion of animal protein sources and plant protein sources should be carefully fixed for achieving the amino-acid balance in the feeds. Suitable carbohydrate sources, lipids rich in polyunsaturated fatty acids (PUFA), phospholipid and cholesterol, vitamin and minerals should be identified and incorporated in the feed formulations. A list of indigenous raw materials consisting of animal and plant protein sources, lipids, carbohydrates, which were analysed and tested for tiger and white shrimp are given in Table 2. The feed formulations are made by selecting the ingredients out of them.

Feed Formulations

Feed formulations are made by selecting the raw materials and proportioning them as per the nutritional requirements of shrimp. There are generally three grades of feeds to be formulated to suit the growing stages of shrimp, namely Post-larvae, Juveniles and Adults (marketable size). These grades are Starter, Grower and Finisher. There can also be sub-grades in each grade. Fish meal,

Table 2: Proximate composition of selected feed ingredients

Ingredient	Percent on dry basis					
	Moist	Protein	Fat	Fiber	CHO	Ash
Fish meal	10.80	55.02	5.40	1.73	3.27	23.78
Prawn head	9.91	39.83	9.60	16.34	4.08	20.18
Squid meal	8.40	66.50	4.40	3.98	5.91	10.81
Clam meat meal	10.10	49.96	8.66	Trace	28.31	7.75
Soybean meal	10.45	51.50	1.00	8.85	19.70	8.50
Groundnut cake	13.05	46.93	5.00	8.90	18.03	8.09
Sunflower cake	7.00	26.69	2.04	30.13	26.37	7.70
Gingelly cake	9.76	38.71	6.00	10.69	15.82	19.02
Wheat flour	12.50	12.50	2.00	1.75	70.00	1.25
Rice flour	12.50	8.07	0.33	Trace	78.64	0.46
Maida flour	12.26	11.07	0.33	Trace	75.16	1.15
Corn starch	13.20	1.78	0.40	1.00	82.62	1.00
Tapioca flour	8.50	2.00	0.50	3.50	68.50	2.4
Yeast	1.40	56.10	2.14	0.33	30.18	9.85
Spirulina	7.8	60.89	9.00	7.53	1.78	13.00

squid meal, prawn head meal and squilla meal are good animal protein sources. Besides having representative levels of essential amino acids, these materials possess good attractant properties for shrimp. Among the plant protein sources, soyabean meal is one of the superior ingredients. Gingelly cake and sunflower cake may be sparingly used along with soyabean meal to balance the protein levels and also the essential amino-acid profiles. Fish oil and lecithin (soya) would meet the PUFA and phospholipid needs respectively. Wheat flour and tapioca starch are good sources of carbohydrate. Vitamin and mineral mixtures may be prepared or commercial products procured and used.

The optimum nutrient levels to be kept in different grades of feeds for tiger shrimp and white shrimp are given in Table 3.

Processing and Production of Feed

The feed production involves grinding of raw materials, mixing, steam conditioning, pelletisation, drying, grading and packing. All the processing stages are important and contribute to the production of good quality feeds. Pelleting process adopted influences the feed production technology.

Pelletization

Shrimp feeds are produced in pellet form. Ring-die pellet mill is employed for commercial production of shrimp feed. The feed production technology developed by CIBA is based on the ring-die pellet mill, which is indigenously available. It has three steam conditioning chambers attached to it. The feed mixture, after passing through the steam conditioning chambers, enters the pelleting chamber which has a rotating die and two rollers. The feed mixture with adequate level of moisture (16-17%) is compacted into pellets passing through the die. The pellets are cut with an attached knife assembly. The length of the pellet can be regulated by adjusting the knife. The smooth working of the pelleting machine and the quality of feed pellets depend on the moisture level in the feed just before it enters the pelleting chamber, temperature and consistency of the feed mixture.

Drying and packing

Shrimp feed pellets produced using ring-die pellet mill will have a moisture level of 12-14% depending upon the initial moisture. This does not require long drying of pellets. However, it is necessary to reduce the moisture that may develop leading to feed spoilage. The feed is therefore dried for a short period in hopper type dryer, then cooled and packed.

Shrimp feed is packed in laminated HDPE bags of 25 kg each.

Water Stability and Binders

Shrimp feed pellets should retain the shape (should not disintegrate) for a reasonable time when they are put into water for feeding shrimp. This can be achieved by using suitable binding materials. This is known as water stability of feed. Starch present in feed formulation can act as binder if it is properly gelatinized. In ring-pellet mill the moisture level in feed is only 16-17% which is not sufficient to fully gelatinize the starch. Hence additional binder has to be used. The shrimp feed technology developed by CIBA includes standardized processing of feed pellets using three different binders namely guar gum, wheat gluten and polymethylocarbamide. The feed pellets produced using these binders have a stability of 6-8 hours in water.

Preparation of different grades of feeds

The physical shape and size of feeds play an important role in feed consumption and feed efficiency by the growing shrimp. Soon after stocking, the post-larvae need starter feed in granular form of 200 to 500 micron size. The size of

Table 3 : Nutrient levels to be kept in different grades of shrimp feeds for semi-intensive farming

Nutrient	Tiger shrimp			White Shrimp		
	Starter	Grower	Finisher	Starter	Grower	Finisher
Crude protein (%)	40-45	38-40	35-38	40-42	35-38	32-35
Lipid (%)	6-8	8-10	8-10	6-8	8-10	8-10
Carbohydrate (%)	10-16	15-20	20-25	10-15	15-25	20-30
Crude fiber (%)	1-2	1-3	2-4	1-2	2-4	3-5
Ash (%)	10-12	10-15	12-18	10-15	10-16	10-18
Energy (Kcal/100g)	350-400	380-420	380-420	350-400	350-400	350-400
Vitamin mix	0.5-2	0.5-2	0.5-2	0.5-2	0.5-2	0.5-2
Mineral mix	2-5	2-5	2-5	2-5	2-5	2-5

feed should be increased to 1.0 mm size as the shrimps grow to 2-5 g size. Then they require grower feed in the form of 1.8 to 2 mm diameter pellets of 3-5 mm length while the shrimp attain a weight of 15-20 g. After that, finisher feed with pellets of size of 3-5 mm in length and 2.0 to 2.5 mm in diameter is given.

Testing of Feeds

The feeds developed were evolved by three tier testing system. Several feed formulations were made in each grade to start with and tested on three different size groups (postlarvae PL-20, juveniles 2-5 g and adults 10-15 g) of tiger shrimp (*Penaeus monodon*) and Indian white shrimp (*P. indicus*) in laboratory experiments. The best performing two formulations were picked up and tested again in the yard experiments. The final formulations were selected from the yard trials. Using these successful formulations, large quantities of feeds were produced in pilot-scale feed mill established at the Muttukadu experimental station of CIBA. The feeds were tested in grow-out ponds belonging to farmers in different locations. The feeds had produced excellent growth of shrimp and gave good FCR of 1.2 to 1.8 : 1 The performance of the CIBA shrimp feeds in terms of growth of shrimp and FCR is highly comparable to the imported commercial feeds. The performance of the CIBA feeds tested on tiger shrimp in grow-out ponds and compared with commercial (imported reputed brand) feed is summarised in Table 4.

Cost of Feed Production Unit

The shrimp feed mill consists of the following machinery for processing raw materials and producing feed: a) Hammer mill and micro-pulveriser for grinding of raw materials, b) Sieve assembly for obtaining uniform particle size for all the ingredients. c) Horizontal mixer for preparing homogeneous feed mix, Steam conditioning of feed mix and imparting binding, e) Pellet mill for producing desired size feed pellets, and f) Cooler dryer for making the feed ready for packing. The capacity and approximate cost of infrastructure and machinery is given below :

B. Machinery

Sl.No	Name of the machinery required	Approx. cost (Rs. in lakhs)
1.	Hammermill	2.00
2.	Micropulveriser	2.50
3.	Mixer (Homogeniser)	1.00
4.	Sieve assembly	1.00
5.	Steam boiler	2.50
6.	Ring-die pellet mill	6.00
7.	Dryer	1.50
8.	Pellet crumbler	1.00
9.	Ancillaries	2.00
10.	Conveyor system	2.50
11.	Installation charges	2.50
	Total	24.50

Variable Costs

Sl.No	*Cost of production of feed*	*Rs. in lakhs*
1.	Cost of feed raw materials for producing 2000 tonnes of feed (@ Rs.22,000/- per tonne)	440.00
2.	Salary (for 12 months)	2.88
3.	Electricity and water charges	12.00
4.	Interest on capital investment (@ 18% per annum)	6.30
5.	Depreciation on machinery (@ 10%)	1.78
6.	Packing cost	7.68
7.	Maintenance cost	3.50
8.	Contingencies	1.00
	Total	**475.14**
	Say	**475.00 (x)**

Manpower

Designation	*No. of persons*
Supervisor	1
Technician (Mechanical)	1
Technician (Electrical)	1
Skilled workers	10

Capacity of the feed mill : 1 tonne feed per hour

Minimum production :2000 tonnes per annum

Species and culture : Semi-intensive/improved extensive culture of tiger shrimp (*Penaeus monodon*) and Indian white shrimp (*Penaeus indicus*)

Fixed Costs

A. Area of building Approximate cost (Rs. in lakhs)

Table 4: Performance of CIBA feed on tiger shrimp in grow-out ponds compared with commercial (imported reputed brand) feed

Particulars	*Tested in*			
	Institute's farm		*Farmer's farm*	
	CIBA feed	*Commercial feed*	*CIBA feed*	*Commercial feed*
Area of pond (ha)	0.2	0.2	1.0	1.0
Stocking density (no/m²)	5	5	10	10
Days of culture	100	100	140	140
Average weight of shrimp at harvest (g)	28.0	28.0	32.0	32.0
Quantity harvested (kg)	237	239	2325	2400
Production (kg/ha)	1185	1195	2325	2400
Harvested FCR	1.23	1.22	1.81	1.63

Industrial type (Roofed area - 350 sq. m.)	1050

Total investment : (A) + (B) = Rs.35.00

Returns

Sale price of feed at Rs.30,000 per tonne (for semi-intensive)

Sale proceeds of 2000 tonnes of feed Rs. 600.00 lakhs (Y)

Gross Profit Y - X Rs. 125.00

Gross returns on variable costs 26.3%

Note : All costs are based on the present available information and are subject to change with location and market forces.

Transfer of Technology

The Central Institute of Brackishwater Aquaculture (CIBA) undertakes transfer of shrimp feed technology developed by it on consultancy basis. The Institute has a pilot scale feed mill at its Muttukadu Experimental Station. For details the Director of the Institute may be contacted.

Acknowledgement

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CIFA's Leading Role in Aquaculture CD-ROM Creation

On 16th January, 2001, on the occasion of inauguration of national workshop on Bioinformatics and Statistics in Aquaculture Research, Central Institute of Freshwater Aquaculture (CIFA) released two CD-ROM's namely (i) Proceedings of National Workshop on Bioinformatics and Statistics in Aquaculture Research-2001 and (ii) Fish Disease Database Information System. The former CD-ROM was designed, developed and created by Bioinformatics Centre of CIFA, while the later one was done in collaboration with IVLP-TAR-NATP of CIFA. The first CD-ROM contains thirty articles contributed during the workshop by subject matter specialists covering Biotechnological Information Resources, Search Engines, Search Technologies, Artificial Intelligence, Expert System, System Dynamics, Probit Analysis, Modeling and Aquaculture Data Analysis Using Statistical Packages. The second CD-ROM being first of it kind contains Fish Disease Database Information System for aquaculture farms. It includes standardized definitions of disease events, systematic classification of diseases, standard disease indices for recording and processing of epidemiological data. The CD-ROM contains 400 pages, which include 250 photographs depicting fish disease events. In this connection it may be mentioned that these are the third and fourth CD-ROM in the the series created by the centre. The CDs with auto run facility may be run in Window 95 or higher with 16 MB RAM. The products were developed with the financial assistance from Department of Biotechnology, Ministry of Science and Technology, Govt. of India and NATP, ICAR. Details about the CDs may be available with Mr. A.K. Roy, Senior Scientist and Coordinator, BTIS or Dr. B.B. Sahu, Senior Scientist and In-charge, IVLP-TAR-NATP or Dr. C. Saha, Director, CIFA, Kausalyaganga, Bhubaneswar.

Pak fishermen sentenced

A total of 133 fishermen from Pakistan and reported to have been sentenced to one and a half years' imprisonment and a fine of Rs. 5,000 each for transgessing into Indian territory without valid passports and relevant documents, by a court in Dwarka town in Jamnagar district of Gujarat. The judge also ordered seizure of 11 boats.

The fishermen were arrested by the Indian coastguard in 1999 while they were trying to enter into the Indian waters off the Okha port located in Saurashtra, violating Foreigners Act.

Artificial propagation of a Silurid fish, Pabda, *Ompok pabo* (Hamilton)

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The Indian catfish *Ompok pabo*, was successfully bred during monsoon season through hypophysation with synthetic hormone preparation, 'ovatide' as well as carp pituitary extract. The broodfish reared with Indian Major Carp in a polyculture pond attained optimum level of maturity. Some of the female brooders were injected with ovatide (3 ml/kg body wt.) and a few-others with fish pituitary extract (16 mg/kg body wt.). Egg release was maximum with the synthetic hormone 'ovatide'. Encouraging results were also there with carp pituitary harmone extract. Hatching percentage was 70% and 50% in ovatide induced eggs and carp pituitary hormone respectively. Special care was taken for of left-over feed, selection of broodstock, their breeding, in larval rearing, and tank management and feed formulation for larvae.

Fig 1. External feature of a mature Pabda, *Ompok pabo* brooder.

Fig 2. Ventral view of a gravid female Pabda, *Ompok pabo* showing bulging abdomen and extruding reddish vent.

Fig 3. Pabda, *Ompok pabo* brooders are injected at bundh

India is fortunate to possess vast and varied fish germplasm resources. About 11% (2,200) of the total world (more than 20,000) finfish species have been recorded from the Indian subcontinent (Das and Pandey, 1999).

Unlike several other Indian States, West Bengal is blessed with several wetlands. The State has skilled farmers and qualified technologists. The Department of Fisheries, Government of West Bengal has been endeavouring to optimize the sustainable exploitation of natural fishery resources in order to elevate the socio-economic status of the fisherfolk of the State. The success in this work lies on the percolation of technologies to the farmers - the most important ancillary of the project.

Due to various anthropogenic stresses like rapid industrialization, habitat destruction owing to river-valley projects, excessive water abstraction, siltation in rivers, mainly due to a deforestation, over-exploitation, illegal killing of juveniles and brood fishes, injudicious application of pesticides, aquatic pollution, spread of dreaded diseases and uncontrolled introduction of exotic fish, a number of indigenous fishes of value are now showing a declining catch trend from the conventional fishing grounds and some have even become threatened, needing immediate conservation (Miller *et al.;* 1989: Master, 1990; Maitland, 1993; Dehadrai *et al.,* 1994; Kirchhofer and Hefi, 1996; Joshi and Raina, 1997; Shrestha, 1997; Ponniah *et al.,* 1998). The authors have identified 39 local fish species of West Bengal on the verge of extinction mainly due to indiscriminate application of pesticides in the agricultural land (Table-I). Pabda, *Ompok pabo* is one of them. Department of Fisheries, Government of West Bengal is endeavouring to conserve this species with the following objectives :

1. Artificial breeding of rare species to

Table -1

List of 39 species of local fishes from West Bengal.

Fresh Water	
Endangered :	1. Ompok Pabo (Hamilton)
Vulnerable :	2. Ailia coila (Hamilton)
	3. Anguilla bengalensis (Grey & Hardwicke)
	4. Bagarius bagarius (Hamilton)
	5. Eutropichthys vacha (Hamilton)
	6. Ompok bimaculatus (Bloch)
	7. Puntius sarana (Hamilton)
	8. Semiplotus semiplotus (Mac Chelland)
	9. Osphromenus nobilis (Day)
	10.Labeo diacanthyus
	11.Anabas testudineus (Bloch)
Intermediate :	12.Notopterus chitala (Hamilton)
	13.Notopterus notopterus (Pallas)
	14.Pangasius pangasius (Hamilton)
	15.Balitora brucei (Grey)
	16.Gudusia chapra (Hamilton)
	17.Labeo fimbriatus (Bloch)
	18.Labeo gonius (Hamilton)
	19.Mastacembelus armatus (Lacepede)
	20.Mystus tengara (Hamilton)
	21.Mystus aor (Hamilton)
	22.Rasbora rasbora (Hamilton)
	23.Setipinna phasa (Hamilton)
	24.Bengala elanga
	25.Wallago attu (Schneider)
	26.Nandus nandus (Hamilton)
	27. Amblypharingodon mola (Hamilton)
Cold Water	
Vuinerable :	28.Tor putitora (Hamilton)
	29.Tor tor (Hamilton)
	30.Raiamas bola (Hamilton)
	31.Barilius vogra (Hamilton)
Brackishwater & Marine	
Vulnerable :	32.Lates calcerifer (Bloch)
	33.Odontamblyopus rubicondus (Hamilton)
Intermediate :	34.Osteogeniosus militaris (Linnaeus)
	35.Periophthalmus koelreutri (Pallas)
	36.Etroplus suratensis (Bloch)
	37.Plotosus canius (Ruppel)
	38.Tachysurus thalassinus (Ruppel)
	39.Polydactylus indicus (Shaw)

Fig 4. Eggs, just fertilised

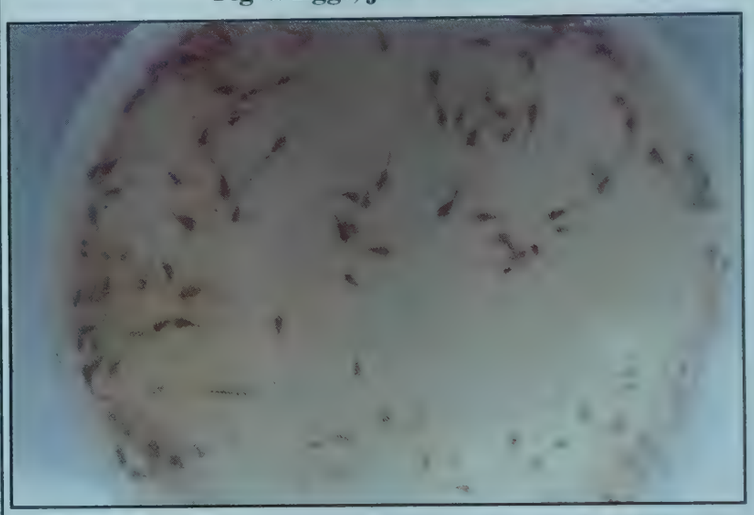

Fig 5. Three days old pabda, Ompok pabo hatchlings

Fig 6. Fifteen days old pabda spawn-eyes, barbel, head region and trunk are clearly visible in naked eye.

make available these endangered species in their natural habitat and restore the gene bank of threatened species.

2. To overcome the problem of diseases during larval rearing and in culture ponds.

3. To generate income, self-employment and skills among interested farmers through demonstration and training, and

4. Technical support to the private hatchery owners for maximizing quality seed production.

Pabda, *Ompok pabo* (Hamilton) constitutes an important component of riverine fisheries in the Indian sub-continent. Sporadic information is available

Table - II

Major water quality parameters in the brooder, breeding and larval rearing tanks of Ompok pabo

Pond	*Temp (°C)*	*pH*	*DO(ppm)*	*NH_4N (ppm)*	*Alkalinity (ppm)*	*Hardness (ppm)*
Brooders	29±1	7.5-8.0	6-6.5	-	130±10	110±15
Breeding	30±1	7.6-7.9	7-7.6	-	140±15	112±10
Larval Rearing	29.5±1	7.5-7.8	6.9-7.2	-	135±15	115±10

on the biology and culture practices of this species (Daya, 1967; CSIR, 1962). *Ompok pabo* is one of the Indian major catfishes belonging to the family siluridae. It dwells and breeds in the rivers and reservoirs and in connected water sheds in flooded condition, during south west monsoon rains. No report on captive breeding of this is available so far either from the Indian sub-continent or elsewhere.

Biological studies related to life-history traits are essential to understand the breeding habits of the fish for standardization of the breeding and larval rearing techniques under captivity. Knowledge in this respect will prove to be a viable aid in conservation and rehabilitation of the endangered species (Das and Pandey, 1999). Considering that maintenance of fish bio-diversity along with other biotic resources is a prerequisite for the well being of even human beings too (Smith and Chesser, 1981; Meffe, 1987; Pavlov, 1993), the strategies involved in artificial propagation for conservation of endangered fish species are briefly discussed in this paper.

Farmers like Dipak Roy of Vill:- Beldanga, P.O. - Singabad of Malda District, West Bengal have been looking for production of quality seeds of Pabda, *Ompok pabo*. But due to lack of standard breeding techniques, Deepak Roy's sincere attempts went in vain, sometimes leading to catastrophe. In this background, the main objective of this investigation is to standardise the breeding and larval rearing techniques of Pabda, *Ompok pabo* and extend the knowledge to the common fish farmer so as to restore the fish to its earlier status in nature.

Broodstock Management

Pabda, *Ompok pabo* juveniles were collected from the river Punarvava, in the vicinity of Malda District, West Bengal, India. They were stocked in a polyculture tank of O.5 ha with Indian major carp. Along with regular liming the fish stock was fed with conventional feed consisting of mustard oil cake and rice bran in the ratio of 1:1. Pabda was maintained throughout the carp culture period. The brooders (Fig. 1). attained maturity after one year and the average body weight was recorded to be 85g. In the month of May both female and male broodfish were found to be gravid.

Adults showed sexual dimorphism. Mature males exhibited roughness of the first ray of pectoral fin at the lower side and possessed a narrow and rather pointed genital papilla, along with free oozing white milt on applying slight pressure on the abdomen. In the case of female (Fig. 2) the pectoral fin was smooth and the genital papilla was found with thick muscular formation around the opening.

Experiments

The spawners were selected for induced breeding experiment in the month of July, 2000. The maturity status of female was assessed using simple cathet ring device (Chowdhuri, 1963). Free oozing males and ripe females were used in the ratio of 2:1 respectively for breeding.

Induced breeding was done in a bundh (Fig. 3). Bundhs are special type of impoundments where riverine conditions are simulated during monsoon months. The bundhs, after a heavy shower, receive large quantities of rain water from their extensive catchment area and provide a large spawning ground (Jhingran, 1982). Brooders were collected from brooder tank and kept in a hapa in the bundh and conditioning was done for 24 hrs. Brooders of average weight of 80 ± 5g were selected for the experiment.

For the breeding operation, three experiments were set up, one with carp pituitary extract, second with synthetic hormone 'Ovaprim' (Syndel, Lab. Ltd. Vancouver, Canada) and third with another synthetic hormone 'Ovatide' (Hemmo pharma, Mumbai, India). For each experiment six male and three females were kept in separate breeding hapas. Single doses of hormone were administered. Male fishes were not injected with hormone preparations. The doses of hormone used were: pituitary 16mg/kg body wt.; Ovaprim 3.5 ml/kg. body wt. and Ovatide 3.0 ml/kg. body wt. Before using, the synthetic hormones were diluted with double distilled water. The main water quality parameters of the brooder tank, breeding tank and larval rearing tank

Table - III

Larvae production of Pabda, Ompok pabo

Set	*Hormone used*	*No. of fish*	*Dose of hormone (per kg. body wt.)*	*No. of egg released*	*Percentage of hatching*
I	Pituitary gland extract	Female=3 Male=6	16 mg -	4200 nos. -	50%
II	Ovatide	Female=3 Male=6	3 ml. -	20500 nos.	70%
III	Ovaprim	Female=3 Male=6	3.5 ml -	550 nos.	Nil

Table III

Piscimix (Mixture of equal quantities of "Protid", "Fiscal" and "Mins"), Chemical composition of "Protid", "Fiscal" and "Mins"

Piscimix		
Protid (each 10 gr.)	*Fiscal*	*Mins (each 10 gr.)*
11. Vitamins	Elemental Calcium Carbonate 4000 mgs.	**Major minerals and electrolytes**
Ratinol 20000 I.U.	Film Coated Vitamin D_3 2000 I.U.	Elemental Calcium 2900 mgs.
Cholecalciferol 4000 I.U.		Elemental Phosphrous 900 mgs.
Alpha – Tocopherol Acetate 4 mgs.	**Trace elements**	
Phylloquinine 4 mgs.	Magnesium	**Trace materials and Electrolytes**
Thiamin hydrochloride 0.8 mgs.	Manganese	Elemental Iron 70 mgs.
Riboflavin 12 mgs.	Copper	Elemental Copper 33 mgs.
Pyridexin hydrocholoride 4 mgs.	Zince	Elemental Zinc 32 mgs.
Cyano Cobalamin 4 mgs	Iron	Elemental Manganese 27 mgs.
Nia Cinamide 80 mgs	Silica	Elemental Iodine 10 mgs.
Cal. Pantothenate 10 mgs.		Elemental Cobalt 2.5 mgs.
Choline Chloride 600 mgs.		
Proteins		
D.L. Methionine 200 mg		
Lysine Monohydrochloride 200 mg		
8 Minerals		
Elemental Calcium 3100 mg		
Elemental Phosphorus 300 mg		
Elemental Manganese 140 mg		
Elemental Ferrous Iron 60 mg		
Elemental Copper 10 mg		
Elemental Zinc 80 mg		
Potassium Iodate 4 mg		
Cobalt 2 mg		

were recorded regularly (Table-II) following the method given by APHA (1955).

Fertilised eggs (Fig. 4) were found free and demersal. Water hardened eggs were small and measured 1 - 1.5 mm in diameter. The number of eggs were estimated by volume and then transferred to the hatching hapa. Females were examined to ascertain whether spawning was complete or partial. The completely spawned fishes were released back in the brood fish pond after giving a dip in a methylene blue solution to avoid any possible infection.

Results

After 22 hours of fertilization, embryos hatched out. Hatchlings were 5 - 6 mm in length, with small yolk sac attached. 24 hours after hatching, the larvae were transferred from the hatching hapa to the nursery tank for further development. Three day old larval have the appearance as at Fig 5. Larvae (Fig. 6) were fed with formulated feed after three days of hatching. Formulated feed was prepared by steam cooking of the mixture of egg and mussel (Karmakar *et al.*, 2000). "Piscimix" powder (Table - IV) was mixed with the prepared feed at the rate of 10 mg/kg. feed. The mixture was then sieved using the to necessary mesh size and later thoroughly washed in tap water.

Among the two synthetic hormones (Ovatide and Ovaprim) and carp pituitary extract, Ovatide gave the best result (Table - III). The number of eggs released with the Ovatide administration was 80% higher than that of pituitary extract and 97 % higher than Ovaprim respectively. Hatching percentage was 28% higher than among eggs released due to adminstration of Ovatide and later fertilised and the number of hatchlings produced were 28% higher compared to those administered with pituitary extract. No hatching was noticed in respect of the eggs released due to administration of Ovaprim.

Discussion

It is apparent from the above results that the experiment is more successful with the synthetic hormone Ovatide. Encouraging results have also been obtained through administration of carp pituitary extract. Results were not remarkable with Ovaprim.

Feeding is the most important factor during the larval rearing period. Formulated feed admixed with piscimix was found to help in combating mortality, while also enhancing survival rates, and

allowing improved growth. Feeding also is seen as checking malnutrition. Piscimix mixture has also helped in maintaining steady growth of bones and strengthening of body muscles.

The induced breeding of *Ompok pabo* is in a way comparable to the induced breeding of carps but the catfish needs special attention in respect of larval rearing. Mostly after 24 hours of hatching ther is a large mortality in the larval population, because some toxicity appeared in the hatching hapa due to deterioration of water quality in it caused by decomposing of egg shell. But after the mortality the rest of the population survived and they grew into fingerlings without presenting any problem.

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Short Term Training Programme on Aquaculture and Trade CIFE - Lucknow Centre

The Lucknow Centre of Central Institute of Fisheries Education, Chinhat, in collaboration with Institute of Aquaculture and Environment, a Non-Governmental Organization, recently organised a Short Term Training Programme on Aquaculture and Trade.

The training held during 11th to 17th Feb., 1001, was attended by 25 fish farmers of Uttar Pradesh. The Programme aimed at extending the latest fisheries technologies available to the fish culturists, like fish culture, prawn culture, fish seed production and pearl culture. These technologies will help generate self-employment among rural youth apart from increasing the fish production and the income of fish farmers.

The programme was inaugurated by Mr. Suresh Chandra Srivastava, MLA, U.P., who said that the leasing of ponds would be made easier to provide self-employment to rural youth. Mr. V.K. Bisht, Manager NABARD, Lucknow, emphasized on availability of finance for fisheries sector through commercial banks.

Broodstock Management, Induced Breeding and Larval Rearing of the Indian Catfish, *Heteropneustes fossilis* (Bloch)

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Air-breathing fish culture holds great promise in rural areas which are estimated to have around 1.3 million ha of fallow derelict swampy waters, unsuitable for carp culture, but can be well utilised for airbreathing fish culture. Air breathing fish are characterized by the possession of an accessory respiratory organ which enables them to exist for hours out of water, or indefinitely in oxygen-poor waters and even in moist mud. They are extremely hardy in respect of various environmental parameters and survive well in derelict and shallow waters having environmental parameters not conducive to fishes such as major carps. The States of Assam, Meghalaya, West Bengal, Orissa, Andhra Pradesh, Karnataka and Tamilnadu support a natural fishery (about 15% of the total inland landings) of air-breathing fishes (Dehadrai and Kamal, 1993). Viable culture system for air-breathing fishes has been developed by the All India Co-ordinated Research Project (AICRP) on Air-Breathing Fish Culture of the earstwhile Central Inland Fisheries Research Institute (now CICFRI), Barrackpore during the seventies. This low input-low risk culture of these fishes is well-suited to the rural as well as suburban development programmes (Dehadrai, 1975).

Heteropnuestes fossilis, commonly knowen as "Singhi", is an important air-breathing fish. It has been identified as a potential candidiate species for aquaculture in derelict and swampy water bodies. It commands good consumer preference due to its taste and high protein, iron and low fat contents. This fish is also believed to have some medicinal properties as and it often recommended for consumption by convalescing people.

Non-availability of seed of the fish is the major constraint for the development of its culture. Experimental work has, therefore,been conducted to standardize the technology for broodstock management, induced spawning and larval rearing of the Indian catfish, *Heteropnuestes fossilis*.

Broodstock Management

Brooders (2 years) of *Heteropnuestes fossilis* were stocked @ 8000/ha in 0.04 ha ponds after normal pond preparation. The pond was manured (cattle dung 1000 kg/ha, urea 50kg/ha and single superphosphate 21 kg/ha per month) periodically to sustain the availability of natural feed. The physico-chemical characteristics of the ponds were - pH 7.1-7.5, temperature 28-30°C, dissolved oxygen 4.1-5.2 ppm, dissolved ammonia 0.05-0.1 ppm and total alkalinity 120-132 ppm. The fishes were fed on balanced diet consisting of fish meal 30%, groundnut oil cake (GOC) 25%, soyabean oil cake (SOC) 20%, wheat flour 10%, rice bran 14.8%, trace mineral mix 0.1% and vitamin mix 0.1%. The diet contained crude 34-35% of protein and gross energy of 4200-430 kcal/kg (Singh *et al.,* 2000). The fishes kept as control were fed with conventional diet comprising groundnut oil cake (GOC) 50% and rice bran 50%. Fishes from both the groups were fed with 2mm pelleted diet @ 3-4% of their body weight once daily and kept together to bring proper gonadal maturation and synchronization of breeding. The broodstock maintained on the experimental diet displayed gonadal maturity by March end whereas those fed with conventional diet matured by June.

Advanced Maturation

The breeding season of *Heteropnuestes fossilis* generally extends from April to July in West Bengal, late-July to October in North India (peak August to September) and July to September in Karnataka (Qasim and Qayyum, 1961; Mukhopadhyay, 1972). However, intramuscular as well as oral administration of human chorionic gonadotropin (HCG) @ 25 IU-50 IU/Kg body weight 5 times over 10 weeks advances maturation in both the sexes by 1-2 months (Kanungo *et al.,* 1989; Das *et al.,* 2000). The species responds well to the ambient photothermal alterations and has been made to breed atleast 5 times by exposing them to long photoperiods during March-July (Sunderaraj and Goswami, 1969; Mukhopadhyay, 1972; Sunderaraj and Vasal, 1976; Nayak *et al.,* 2000). Fecundity of the females varies from fish to fish depending on size and growth. However, in general, one gram of ovary contains 1,500-2,000 eggs. Ripe males with freely oozing milt and females with soft bulging abdomen were chosen for induced breeding experiments.

Induced breeding

Heteropnuestes fossilis has been successfully bred by homoplastic pituitary extract (females 70-80 mg/kg; males 60-65 mg/kg). The fish bred after 8-10 hours of the injection (Khan and Mukhopathyay, 1975). However in later studies, the dose was reduced considerably (Nayak *et al.,* 2000). The authors tried a number of hormonal combinations to succeed in induced breeding of the Indian catfish: (i) Pituitary gland extract (PGE) 15-20 mg/kg, (ii) Ovaprim 0.6-0.9 ml/kg, (iii) LHRHa^{+} pimozide LHRH 50mg^{+} pimozide 5 ml/kg, (iv) 17 - hydroxyprogesterone 8 mg/kg and (v) 17 , 20 b - dihydroxyprogesterone 2 mg/kg. The fish responded very well to intramuscular administration of the synthetic drug, Ovaprim (Syndell Laboratories, Vancouver; sGnRH +domeperidone) @

females 0.5 ml/kg and males 0.25 ml/kg. After 10 hours of injection, testes were dissected out from the males and squeezed in 0.96 ml saline using mortar and pestle. The females were stripped by applying gentle pressure on abdomen and the fish spawned profusely and the eggs were fertilized with the help of a bird feather (Kanungo *et al.,* 1999; Nayak et al., 2000). Interestingly, pond-raised broodstock of singhi were successfully bred with the indigenous formulation, Ovatide (Hemmo Pharma, Mumbai) too at the dose of 0.3-0.5 ml/kg body weight (both sexes) (Koteeswaran *et al.,* 2000). About 80-90% fertilization was achieved at 28-30°C. The embryo hatched out between 16-22 hours after fertilization.

Larval Rearing

Since the yolk sac gets absorbed in about three days, thereafter, external food in the form of natural organisms such as plankton and minute rotifers, egg custard, hatched nauplii of Artemia was provided (5 times/day) for proper growth of the catfish larvae. The feed comprised (i) boiled egg and minute rotifers 1-2 days, (ii) zooplankton (rotifers and cilliates 3-12 days, (iii) hatched Artemia larvae 4-7 days and (iv) chopped/crushed molluscan meat and zooplankton for 13 days. The feeding pattern gave very good survival in fry of *Heteropnuestes fossilis*. The fry when reared in hatcheries for 20-22 days, is seen to grow into juveniles. Stocking of advanced fry in nuseries @ 300-500/m^2 and rearing them for 15-30 days gave good results. Finely minced trash fish and molluscan meat + rice bran (1:1) or supplementary feed of suitable size is found to promote growth when @ 5-10% of the biomass daily in evening hours. The balanced diet developed for advanced fry and fingerlings of singhi comprised: (a) fish meal 20%, groundnut oil cake 30%, GOC 30%, soyabean oil cake (SOC) 10%, wheat flour 20%, rice bran 19.8% and mineral mix 0.1% and (b) chicken egg content (albumin and yolk) 40%, wheat flour 20% or corn flour 10%, GOC 27/8%, Ca HPO_4 2%, trace mineral mix 0.1%, multivitamin 0.1% and vitamin C 20 mg/kg. After 30 days of rearing in the hatcheries, the fingerlings can be collected by small hand nets for stocking in bigger ponds for growout operations, which need considerable streamling and standardisation.

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Aquarium at Digha in West Bengal

The Marine Aquarium and Research Centre at Digha in Midnapore district of West Bengal, work on which was completed long back, could not made operational as yet, it is learnt. Despite the Zoological Survey of India authorities taking all possible steps to initiate functioning of the aquarium, which is well equipped, the centre is facing acute difficulty in the storage of sea water essential for the preservation of crocodiles and various types of marine fishes meant for research purposes., it is reported. It is learnt the sea water pumped into the station from the Bay of Bengal has large quantities of mud blocking the flow of water to various panels. Filters are now being installed to get over the problem, it is stated.

A feasibility study on dry fish packaging in the State of Meghalaya

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Meghalaya is one of the important hill states of North Eastern India, located at an altitude of 1496 m above msl. The State has three important tribes mainly *Khasi, Jainantia* and *Garo*. Shillong, the capital city has a mixed population of Bengalis, Assamese, Manipuris, Nagas, Mizos and Nepalis, apart from three principal tribes mentioned above. A large percentage of the population are regular fish consumers. At present more than 80% of the total requirement of fish are imported from outside the State, as fish production in Meghalaya is as low as 3578 t per annum. Although the Government of Meghalaya is currently giving importance to pisciculture sector, not much could done with regard to production of value-added items such as dried fish, dry-salted fish etc.

Dry-salted fish is very popular as a delicacy among tribal people. So much so, the product commands a lucrative market in Meghalaya. A recent survey has revealed that 90% of the population is willing to pay some extra price for well-packed quality dry fish product. In Meghalaya, two important dry fish products namely, 'Tungtup' and 'Shymprong' are locally produced and marketed. These are produced as follows:

1. TUNGTUP : The Khasi-Jaintia community mainly consume this particular product. People of Dawki and Pynursla are generally involved in the production of Tungtup. The species that is used to produce this product is mainly *Puntius* species (*Tungmluh*-khasi name). These fishes collected from the natural habitat i.e., paddy fields, streams, rivers etc., are first washed thoroughly with water. They are later kept in earthen pots with layers of salt. Fish oil (conventionally prepared) is mixed with the product to get a fishy smell. The pot is then covered with earth and kept for a certain period until the moisture content of the product is reduced. The fishes are then wrapped in a conventional way and brought to the market for sale.

2. SHYMPRONG : This is also produced in Dawki and Pynursla region. The species used are small river prawns and shrimps. These are collected from rivers and streams. After collection, the fishes are sun-dried in a somewhat raised manner above the ground and the resultant product is then sold in the market.

A feasibility study was conducted recently at Shillong, the capital city involving 50 respondents. This survey threw some light on the preference of the consumers which is taste-based. The respondents were selected randomly from different locations and localities, belonging to different communities and having house-hold income ranging from Rs. 5000 to Rs. 20,000 per month.

Through this survey it was found that 60% of the respondents consumed dry fishes with an average consumption rate of 50 g to more than one kg per month and the range of consumption is seen to depend on the house-hold income and the number of members in the family. It was found that the average number of members in a family is five and the average consumption rate is around 200 g every month/family. In addition to 'Shymprong' and 'Tungtup' other varieties of dried fishes such as Sidal, Bombay duck, etc., also fetch very good price in Shillong market. About 90% of the respondents prefer rohu fish in dry-salted form. From this, it can be concluded that a very good market of dry-salted rohu fish exists in Meghalaya. Das (1997) also reveals that there is a good market and demand for Rohu fish in fresh condition too, and that usually the fish is sold more during winter months in Shillong fish market.

During the survey almost everyone has given his or her preference to hygienically improved and well-packed dry fish product. Currently dry fish in Shillong is usually sold as an open item in the market and the product is not very clean and hygienic. The introduction of a well-packed product can command a good market, specially for the health conscious segment.

From the survey, it can be concluded that setting up of a dry-salted fish packaging unit would be worth its while, because the consumption of such value-added fish is preferred and demand is high in Shillong. Moreover, for a segment of the population, especially those who are health conscious, a hygienically

Table : Summary of the survey conducted on dry fish Packaging in Meghalaya

Community	*Average consumption of dry fish per month*	*Preferred variety of dry fish*
Khasi	200	'Shymprong', 'Tungtup', Bombay duck
Garo	50	Prawns, 'Tungtup', Bombay duck
Bengali	100	Sidal, Bombay duck, 'Shymprong'
Nepali	125	Sidal, 'Tungtup', Bombay duck
Naga	75	'Tungtup', Prawns, Bombay duck
Manipuri	500	Bombay duck, 'Shymprong', 'Tungtup', Small fishes

improved packet of dry-salted fish would be more appealing.

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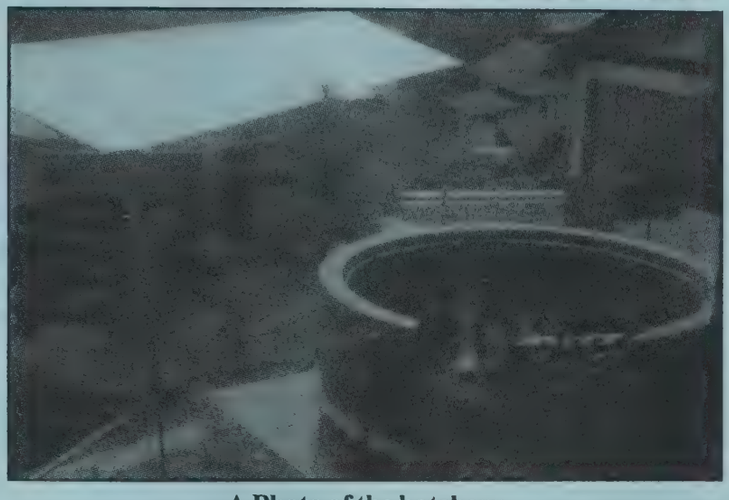
Successful induced breeding of carps in Shillong, Meghalaya

Shillong, the State capital of Meghalaya in the North Eastern India is situated at an altitude of 1496 m above msl. The State has a mid-altitudinal fishery with a variety of cold water fish species. Meghalaya often depends on other States for supply of fish seed for stocking in various water bodies of the State. The lack of locally available quality fish seeds of desirable varieties is considered one of bottlenecks in promoting aquaculture.



A Photo of the hatchery

During 1998-2000, the department of pisciculture of St. Anthony's College, Shillong, a premier institution of the State, implemented a project sponsored by the department of biotechnology on hatchery construction and fish breeding for teaching, research and extension activities. The primary objectives of the project were to produce quality fish seed, conduct research and to educate the rural tribal people in scientific fish farming. The scientists of the pisciculture department were successful in breeding warm water carp fishes at a temperature range of 18-23° C for the first time in the State. Before the commencement of the breeding season, a few brood fishes were brought to the laboratory and were reared in a specially designed pond with high protein diet. For induced breeding, pituitary gland extract, and synthetic hormone products, Ovaprim of Glaxo and Ovatide of Hemmo Pharma, were administered to brood fishes. This initiative has resulted in the release of eggs, their fertilisation and later hatching leading to spawn production. The scientists of the department of pisciculture, namely Mr. R.N. Bhuyan, Mr. D. Sarma, Dr. D. Ghose and Mr. S. M. Kharbuli were associated with this project and they succeeded in induced breeding of carps, *Labeo rohita, Labeo gonius* and *Cyprinus carpio* (Common carp) in the first year of setting up of the hatchery. Upon request from the department of pisciculture, Dr. S.K.Das, Associate Professor, College of Fisheries, Assam Agricultural University, provided technical assistance in the breeding of fish and designed a medium - scale carp hatchery considering the resource availability and needs under this project. To date this is the only functional hatchery of Meghalaya State. The scientists of the pisciculture department produced a large amount of fish seeds in the year 2000 using this hatchery and earned a substantial income from the sale of fish seeds.

Strike ends

THE National Fishworkers' forum (NFF) has called off its nation-wide strike following the Government's assurance that steps would be taken to remedy anomalies in the policies affecting fisherfolk all over the country.

Fisherfolk in various parts of the country began their agitation on January 8 and were gearing up for a nation-wide strike to commence on January 18.

The strike was called off consequent to a meeting between the NFF representatives, Father Thomas Kocherry and Mr Xavier Pinto, and the Union Agriculture Minister, Mr Nitish Kumar, and the Petroleum Minister, Mr Ram Naik.

It will be recalled that the Federation had demanded the withdrawal of the Aquaculture Authority Bill stated for introduction in the Parliament, adequate supply of diesel and kerosene to fishermen at subsidised rates and implementation of the Murari Committee recommendations etc.

Demonstration against Foreign Fishing Vessels Operations at Visakhapatnam

The members of the Mechanised Fishing Boat Operators Association, Trawler Workers Welfare Association and a large number of Fishermen of Visakhapatnam merched from the Fishing Harbour to the Collectorate in a massive rally, demanding that the government should immediately ban the operations of foreign fishing vessels along the Indian Coast. Mr. Hari Krishna Debnath, General Secretary, Forum of Fisher People, Representatives of National Fish Workers Forum, Mr. P. Lakshmayya and several others addressed the rallyists. They presented a Memorandum containing their demands to the Collector. The other demands mentioned therein were related to supply of disel oil and Kerosene on subsidy basis to fishermen. They also wanted legal action to be taken on such of the fishermen who continued to conduct fishing despite the ban imposed by the government. It was also demanded that the Aqua culture Authority Bill recently introduced in the Parliament should be withdrawn.

Status of Freshwater Prawn Farming in West Bengal

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Research and development in respect of freshwater prawn farming in India has been in an upward swing for the past several years. The motivating factor in this respect is the determination to strengthen the position in the export of prawns in the world market. Further, in most of the States prior attention is being paid for the development of freshwater prawn farming because of the higher returns due to the export value of the commodity. West Bengal is no exception to this.

More than forty species of *Macrobrachium* occur in India waters, but only a few of them are available in West Bengal. Among the available freshwater prawns, *Macrobrachium rosenbergii* (giant freshwater prawn, commonly known as Scampi) is found to be the most suitable one for farming in the State due to its attractive size, growth and lucrative price it fetches. At present, the production of freshwater prawn (scampi) is reported to be 1,829 tonnes (1999-2000) in the State.

In the light of environmental and ecological problems in intensive culture of brackishwater shrimp, culture of *M. rosenbergii* has immense scope to flourish because the technology for culture of the species in large scale is not detrimental to the ecology and environmental conditions of cultivable waters. However, due to diverse ecological conditions and soil characteristics in the State, the yield rates of the same vary from place to place.

Freshwater prawn farming, under monoculture and polyculture systems, has assumed greater significance, as the induction of prawn into freshwater aquaculture system has given fillip to substantial improvement in the profitability of aquaculture, triggering its expansion and elevation into an industry.

In West Bengal, traditional system of culture of giant freshwater prawn is mostly practised by the farmers. This does not ensure any stable crop of the species. However, as a refreshing development, in recent years, scientific prawn farming has gained momentum and inland water bodies are presently being utilized for boosting up prawn production.

Export of freshwater prawn

Freshwater prawn has emerged recently as one of the important products for export. Frozen scampi is exported in various forms such as Head-on, Headless, in Block frozen and Individual Quick Frozen (IQF) from the country, with a remarkable contribution from West Bengal.

Resources

Water bodies: The State is endowed with vast freshwater and estuarine water resources which harbour good prawn fauna, which provide ample scope for their farming. Table I indicates inland water resources of the State.

Germplasm: Though *M. rosenbergii* has carved a place for itself in profitable commercial cultivation, there are few other species (Table II) under the genus *Macrobrachium* which can also be cultured in freshwater bodies of the State.

Operational area: The giant freshwater prawn, *M. rosenbergii* has become one of the coveted candidates for aquaculture in some of the districts in the State. Due to non-availability of conducive physico-chemical soil and water characteristics, the production of prawn has been reported to be poor in some of the districts which discouraged the farmers of the area

Table I. Inland fishery resources of West Bengal

Resources	Area (ha)
1. Tank/Ponds	2,16,201.00
2. Beels/Baors	41,781.65
3. Rivers	1,72,586.36
4. Reservoirs	16,738.80
5. Sewage-fed	4,083.00
6. Canals/Creeks	80,085.00

(Source : Directorate of Fisheries, Govt. of W.B., 1995)

Table II. Growth status of allied Macrobrachium species in the State

	Species	*Maximum size (cm)*
1.	*M. rosenbergii*	Male 32.0
		Female 24.0
2.	*M. villosimanus*	Male 14.6
		Female 11.7
3.	*M. lamarrei*	6.9
4.	*M. malcolmsonii*	Male 23.0
		Female 20.0
5.	*M. rude*	13.0
6.	*M. idella*	Male 10.0
		Female 15.0
7.	*M. mirabile*	Male 4.0
		Female 6.0
8.	*M. birminicum choprai*	Male 20.0
		Female 13.1
9.	*M. birminicum birminicum*	Male 31.5
		Female 14.7
10.	*M. scabriculum*	Male 7.0
		Female 8.4
11.	*M. dayanum*	Male 9.2
		Female 8.4
12.	*M. equidens*	8.0 to 11.0

Table III. Actual operational area under freshwater prawn farming	
District	**Actual operational area (ha)**
1. Nadia	457.95
2. Burdwan	206.18
3. Midnapore	656.59
4. Hooghly	461.21
5. Howrah	212.02
6. North 24-parganas	993.96
7. South 24-parganas	1192.80
Total	4180.71
(Source : Paria, 2000)	

to take up prawn farming. Recent study indicates that at present 4,180.71 ha water area is utilized in the State for giant freshwater prawn farming, the break-up of which is given Table III.

Seed availability: In West Bengal, the juveniles of freshwater prawn are available in river Hooghly and its tributaries. The present demand for seed of giant freshwater prawn as stocking material is, by and large, met from natural collections. The natural prawn seed resources in West Bengal are discussed below :

a) Midnapore District

1. Silabati river in Ghatal : Maximum seed availability is during April and May.

2. Keleghai river in Potashpur and Egra area, Khejuri and Kalinagar area: Maximum quantity of seed is available during July to October.

3. Subarnarekha river (Rajghat and Datan area) : Maximum seed availability is from July to September.

4. Rasulpur river (Rasulpur) : Maximum seed availability is during July to September.

5. Haldi river (Narghat, Haldia, Terpekha ghat) : Maximum seed availability is during June to September.

6. Kansabati river (Dobandhi, Srirampur, Rajghachtala, Ramchandrapur) : Maximum quantity of seed is available during June to September.

7. Chandia river (Sabang, Pingla and Moina) : Maximum seed availability is during June to September.

8. Rupnarayana river (lower part) Kolaghat : Maximum quantity of seed is available during July to September.

b) North 24 Parganas District

1. Ichhamati river : maximum quantity of seed is available during June to October at certain places, namely Baduria, Swarupnagar, Gaighata and Itindaghat.

2. Bidhyadhari river (Nazat) : Maximum quantity of seed is available during July to September.

c) Hooghly District

1. Mundeswari river : Large quantities of seed is available during April to June.

2.Darakeswar river : Seed is sold in Bandarghat, Tungirghat and Garerghat area during June to August.

d) Nadia District

1. Hooghly river : Good quantity of seed are available in the month of April to June in the river Hooghly near Chakdah area.

2.Churni-Mathabhanga river : Seed is available during June to September at certain places, namely Benali bazar, Harikhali, Balikamari, Mathabhanga, Ranaghat and Simurali, Hanskhali, Swarnakhali, and Majdia.

e) Murshidabad District

1. Jalangi river : Seed is available in the month of June to September.

2. Paglachandi : River seed is available during July to September.

f) Howrah District

1. Damodar river : Maximum quantity of seed is available during July to September.

2. Rupnarayan river (middle part): Maximum quantity of seed is available during August to September.

Seed Production in Hatcheries

The need for hatcheries to commercially produce seed of freshwater prawn for supply to farmers for culture has been belatedly realised. Nevertheless, fourteen hatcheries for the purpose have been set up in the private sector in the State and are functional.

Prospects of Freshwater Prawn Farming in West Bengal

West Bengal, being rich in freshwater resources and with conducive agro-climatic conditions, has immense scope for large scale scampi culture. The three basic needs i.e., seed, feed and breed are being progressively fulfilled. The wild seed as well as seed from hatcheries have been meeting the needs of stocking. Different formulae of artificial feed preparation have been developed. Economically viable technologies are also developed for successful prawn farming. Shallow and marginal areas of wetlands, reservoirs etc., offer ample scope for undertaking pen culture system for growing prawns. The wetlands develop bottom algal matrix called 'lab lab' and also promote growth of periphyton on some leafy substrates. These conditions provide scope for stocking of prawn seed into the system and take out viable crops eventually.

It is now fully realized that inclusion of freshwater prawn in our aquaculture system will make it more productive and highly economical, besides helping in creation of a healthy ecosystem. This would, of course, require proper managerial inputs, keeping an eye on environment. Because of this and in view of the reasons and potentialities available in the State for both capture and culture of giant freshwater prawn, a planned strategy needs to be chalked out for its scientific culture in different ecosystems. Moreover, the advantage of short-term culture period for scampi *vis-a-vis* high returns will help to popularise farming of scampi throughout the State.

Achievements and Scope of Prawn Farming in West Bengal

In West Bengal, *Macrobrachium rosenbergii* is either cultured alone or in combination with other crops under in-

Table IV. Attitude of fish farmers towards giant freshwater farming		
Sl.No.	*Attitude*	*Percent*
1.	Favourable	67
2.	Neutral	12
3.	Unfavourable	21
(Source : Bhaumik *et al.*, 1998)		

tegrated systems or as an ancillary commodity of a fish production system. At Rahara Research Centre (ICAR), the prawn yield was reported @ 499.8 kg/ha/ 8 months. At Canning area, from experimental paddy plots, in 3 months of Khariff crop, prawn and fish yields have been reported as 500 - 600 kg/ha in which contribution of prawn was 40 percent. In Minakhali-Malancha area fish farmers opted for paddy-cum-fish/prawn culture under traditional system. The average yield of aquacrop from the system has been reported as 825.7 kg/ha/7 months where contribution of *M. rosenbergii* was 0.6 per cent. *M. rosenbergii* along with crops under polyculture system at density of @ 500/750/1,000 nos./ha (stocking density 5,000 nos./ha), yield rates exhibited were 13.5 kg, 20.25 kg and 27.0 kg/ha/yr respectively.

Production of *M. rosenbergii* under semi-intensive monoculture system at farmers' fields ranged from 427 to 688 kg/ ha/5 months. Prawn production from pen culture system in wetlands, under the management of Fishermen Cooperative Societies and supervision of CIFRI ranged between 788 and 1,000 kg/ha/4 months.

Mostly, traditional system for culture of *M. rosenbergii* is practised by the farmers in paddy plots, bheries and ponds which do not ensure any steady and substantial yield of the species. The landing of the species from estuaries is also very meagre i.e., hardly one percent of the average total prawn catch. Hence, the technologies so far developed for prawn farming, if put into practice would not only enhance prawn production from the cultivable waters but also help in the generation of employment opportunities and strengthen economic conditions of farming community. Thus, there is ample scope for development of prawn farming in inland lentic waters of the State.

Impressive initiatives have also been taken by the farmers to graduate into semi-intensive prawn farming in the State in the recent past. However, if progress under this initiative is to be sustained and accelerated in the future, a high level technological back-up and specialised trained core personnel for extension work are essentially required.

Attitude of Fish Farmers towards Giant Freshwater Prawn Farming

An investigation was carried out in five districts of West Bengal through a structured schedule and 100 farmers selected at random were personally interviewed. With the help of the schedules an attempt was made to determine whether the prawn producers had favourable or unfavourable perceptions towards giant freshwater prawn farming. The producers' responses towards scampi farming are presented in Table IV.

The study clearly indicates that 67 percent of the respondents had favourable attitude towards giant freshwater prawn farming. This confirms that giant freshwater prawn farming is a profitable venture. However, 21 and 12 percent of the producers respectively had shown an unfavourable and neutral attitude towards the same (Table IV). These producers might have less and/or unsuitable water body or some constraints towards adoption of prawn farming technology.

Table V. Co-efficient of correlation between socio-economic factors and attitude towards giant freshwater prawn farming

Sl.No	Socio-economic fators	Correlation co-efficient (r value)	Status
1.	Age	0.0899	Non-significant
2.	Education	0.4702*	Significant
3.	Caste	0.0839	Non-significant
4.	Occupation	0.1113*	Significant
5.	Social participation	0.0625	Non-significant
6.	Income	0.2341	Non-significant
7.	Experience	-0.0435	Non-significant
8.	Farm size	0.2721**	Significant
9.	Area under prawn farming	0.2930**	Significant
*(Source : Bhaumik et.al. 1998) (Significant at .01**, .05*)*			

Relation between socio-economic factors and attitude towards Scampi

From the following Table V, it can be seen that the factors such as education, occupation, farm size and area under giant freshwater prawn farming were found to be positively and significantly correlated with attitude towards giant freshwater prawn farming. Educated farmers with fish farming as primary occupation realised the merit of giant freshwater prawn farming in terms of its economic returns in a better way than the less educated farmers. The larger farm size, the higher coverage of water area brings greater returns to the prawn farmers. All these contribute to their favourable attitude towards giant freshwater prawn farming. Other factors such as age, caste, social participation, income and experience had no association with attitude towards the same.

Problems in giant freshwater prawn farming

Management of giant freshwater prawn culture system involves care of the animals, maintenance of environment and precautionary measures to counter unforeseen threats and natural calamities. Prawn farming has a number of problems

associated with it. These are :

1. Giant freshwater prawn farming is and in all probability will be capital intensive. As such, it will not fit into the existing social, economic and production relations of small scale resource-poor rural communities.

2. Non-availability of quality seed of desirable size, numbers and in time often hampers the initiation of prawn farming. Seed produced in hatcheries is reported to be too meagre to meet the full demand of the farmers. So, farmers procure wild seed which is admixed with undesirable varieties and it cannot be segregated, easily with their existing knowledge.

3. Non-availability of quality feed also seriously affects prawn farming. Prawns need high level of dietary protein for their growth. Quality feed with high protein content costs high which small scale and resource-poor farmers cannot afford. This results in poor production.

4. Limitation of abiotic factors associated with soil and water of an area affects prawn production *vis-a-vis* adoption of the technology. Prawns, as we know, have a grazing nature and their locomotion is mostly confined close to the soil-water interface. Thus, the ecological condition of the subsurface water is most crucial for prawn health. Any physico-chemical stress in this region will definitely cause distress to prawns and may prove to be fatal depending upon severity.

5. A distinct technological gap in respect of skills and aptitudes exists towards prawn farming which is reflected in the inadequate knowledge of resource-poor farmers.

6. Non-availability of funds towards input costs related to scientific management practices often prevents farmers from adeoption of proper technology.

7. Social problems like poaching and poisoning etc., due to enemity often compel farmers not to take up, prawn farming despite its lucrativeness.

Conclusion

Dissemination of giant freshwater prawn farming technology has the potential to revolutionize the rural scenario of West Bengal. It will not only generate considerable employment opportunities but will also boost incomes resulting in uplift the of rural economy. Adequate information on the technology needs to be transmitted to the ultimate users through competent extension personnel. In this regard, extension work has to be organised keeping in view the constraints and priorities as perceived by the farmers. Today, besides scheduled extension services, a large number of NGOs have been functioning in the State for the socio-economic transformation in rural areas. The need at the moment is to involve them also to popularise the technology.

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Introduction of Tuna Long Lining; AIFI's representation

It is learnt that the Association of Indian Fishery Industries has recently submitted a representation to Joint Secretary (Fisheries), Dept of Animal Husbandry and Dairying to introduce a scheme for the installation of tuna longlining equipment as an additionability on 30 out of 90 deepsea fishing vessels of 23-27 and OAL owned by its members and now operational in the Indian EEZ. The association, explaining that the cost of installation of tuna longlining equipment on the 30 vessels would come to Rs. 19.65 crores, represented that 50% of this, coming to Rs. 9.83 crores, may be provided as one time capital subsidy by the government. It is also requested that the remaining Rs.9.83 crores may be granted as soft loan from the Technology Capital Fund. The Association explained that the provision of financial assistance as mentioned above would enable the operators to take up exploitation of the presently sparsely exploited tuna resources of the Indian EEZ and also of Indian Ocean for National benefit.

Read *Fishing Chimes*

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Status of Development of Fisheries of Pong Reservoir *(Himachal Pradesh)*

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MORPHOMETRIC FEATURES	
General	
Location (district)	Kangra
Name of the river	Beas
Water source	melted snow & monsoon run-off
Type of Dam	Earthen
Height (m)	132.59
Altitude Height (m above MSL)	435.86
Year of commissioning	1974
Lat / long	3205'N/76.05°C
Purpose	Multipurpose
Catchment area (sq.km)	12562

Reservoir	
Waterspread area FRL (ha)	24529
Waterspread area at DSL (ha)	14312
Average waterspread area (ha)	14600
Mean depth (m)	75.0
Total length (km)	41.8
Widest stretch (km)	19.0
Shoreline development index	560.0
Annual water level fluctuation (m)	384-433
Max.water level fluctuation (m)	117.0
Gross storage capacity (mill.cub.m)	8570
Live storage capacity (mill.cub.m)	7771
Inflow (mill.cub.m)	8215-13134
Outflow (mill.cub.m)	6855-13641

Impounded across the river Beas in the State of Himachal Pradesh, the Pong reservoir with a catchment area of 12,561 sq.km. and mean waterspread area of 15,662 ha., was formed during the year 1975. This reservoir occupies an important position among the large man-made reservoirs of India. Completed during the year 1974, the Pong reservoir was constructed primarily for power generation, irrigation and flood control. Fish production aspects were not given any reckoning during the planning or pre-impoundment stages, though the river Beas had a wide array of resident and migratory fish fauna. During the initial years, the catches were dominated by rheophilic course residual species belonging to families Salmonidae, Cyprinidae, Cobitidae, Sisoridae etc. However, in view of the biogenic capacity of the ecosystem and systematic stocking over a number of years with mirror carp and Indian major carps, the catch structure of the reservoir completely altered and the carps accounted for as high as 61.6% of the total landings during 1987-88. The per hectare yield of the reservoir also increased significantly from a meagre 6.5 kg per ha. during 1976-77 to 53.1 kg per ha during 1987-88. Cat fishes and carps accounted for 70.1% and 29.9% of the total production of the reservoir during 1982-83 against 27.8% and 67.6% during 1989-90 respectively. This paper discusses the catch trends of different species, effect of fish seed stocking and trends of fish rates during the last five years.

Catch Trends

A total of 27 fish species (sub-species, varieties) belonging to six families have been encountered in Pong reservoir. The major fishes currently encountered in order of abundance are : *Mystus seenghala, Tor putitora, Labeo rohita, common carp, Catla catla, Cirrhinus mrigala, Labeo calbasu, Channa* spp, *Labeo dero* etc.

A perusal of indigenous carp composition in the total catches from 1976 to 1999-2000 indicated that they dominated over cat fishes till 1991-92. From this year carp catches declined. During 1991-92, the carps viz., *L. rohita, C. catla, C. mrigala* and *L. calbasu* accounted 46.3% (225 tonnes) of the total catches while cat fishes viz., *M. seenghala, Wallago attu* accounted for 37.9% (60 tonnes) and others 2.4% (12 tonnes). Against this, during 1999-2000 the percentage composition of indigenous carps, cat fishes, Mirror carp, *T. putitora* and others was 18.83% (84 tonnes), 56.98% (258 tonnes), 2.89% (13 tonnes), 19.88% (90 tonnes), 0.9% (4 tonnes) respectively.

Among the Indian major carps, *L.rohita* is the dominant fish encountered in the reservoir. The highest catch (339 tonnes) of this fish was encountered during 1987-88. For the last five years 1995-96 to 1999-2000, the catches have fluctuated between 36 to 65 tonnes. During 1999-2000 the landing of *L.rohita* was 65 tonnes. *C.catla* has always kept a low profile in the reservoir i.e., the maximum (22 tonnes) was encountered during 1996-97 , in the recent years . The catches during 1999-2000 were 11 tonnes. *C.mrigala* ranged from 2 to 8 tonnes only. *L.calbasu* too used to have a significant presence in the reservoir during eighties, the highest being 85 tonnes during 1982-83. The catches of this fish plummeted to a level of 3 tonnes during 1997-98.

Pong reservoir may be categorised now as Mystus reservoir. *M.seenghala* has been showing constant increase during the last 10 years. The highest catch (257 tonnes) was recorded during 1999-2000 accounting for 57% of the catch. *W.attu*, however, suffered a decline and an all time low (1.4 tonnes) was recorded during 1999-2000.

Mirron carp composition is quite erratic in the reservoir presumably due to the fact that ideal breeding grounds are non-existent in the water body. However, regular stocking has helped in the revival of mirror carp fishery and for the last eight years there has been a progressive increase in its presence followed by an all time low of two tonnes during 1992-93.

Inventory Data

Inventory data on Fishermen, Gear & Crafts from Pong reservoir during the last 5 years

Sl.No.	Particulars	Unit	1995-96	1996-97	1997-98	1998-99	1999-2000
1.	No. of Fishermen's Societies	(nos.)	12	13	13	13	14
2.	Membership	(nos.)	1439	1631	1782	1825	1943
3.	No.of Gill net licences issued	(nos.)	2142	2424	2704	2756	2934
4.	No.of fishermen registered	(nos.)	1071	1212	1352	1378	1467
5.	No.of Anglers registered	(nos.)	157	199	126	221	191
6.	Fish production	(mt.)	329.7	397.3	414.8	359.8	653.1
7.	No.of fishes caught	(nos.)	2,31,736	2,75,660	2,86,533	2,45,597	3,35,031
8.	Value of fish caught	(lakhs)	112.7	169.1	178.9	160.1	218.3
9.	Royality fee	(lakhs)	17.10	25.16	26.81	24.04	32.73
10.	No.of illegal fishing cases registered	(nos.)	384	408	413	419	443
11.	Compensation realized	(Rs.)	57,820/-	67,635/-	65,360/-	64,715/-	72,045/-
12.	Value of confiscated fish auctioned	(Rs.)	10,509/-	10,569/-	5967/-	7732/-	12,688/-
13.	Total Revenue	(lakhs)	19.11	27.45	29.14	26.39	35.42

only to show an increase to 17 tonnes during 1997-98. The catches during 1999-2000 were 13 tonnes.

Mahseer is a highly precious and sought-after fish of Pong reservoir. It is probably the only reservoir in the country, which provides the opportunity of Mahseer angling. The catches of Mahseer in the reservoir have shown remarkable consistency during the past 10 years and landings have fluctuated between 50 to 90 tonnes a year. The highest catch of Mahseer was recorded during 1999-2000 i.e., 90 tonnes.

Average size of Major Species

An analysis of data for the last 19 years (1982-83 to 1999-2000) indicates that average size of all species of Indian major carps has progressively increased in the water body. *L.rohita*, the principal fish, has registered an increase in weight with a range of 1.4 to 6.4 kg, the average increase during the last three years being 5.7 kg. Average size of *L.rohita* however decreased from 6.4 kg to 5.9 kg during 1999-2000 which indicates the positive results of stocking of this species. *C. catla* catches are more pronounced, being 18.5 kg during the same period. *C. mrigala* and *L.calbasu* too have registered an increase in average weight and the respective figures in terms of average weight for the last three years (1997-98 to 1999-2000) were 3.6 and 1.6 kg. respectively. *C. mrigala* showed an abrupt decrease in average size from 4.7 kg. (1998-99) to 1.8 kg. (1999-2000) which also indicates the new recruitment and positive results of stocking of this species.

Mirror carp however has shown a steep decline in average weight during last few years. This may be attributed to spurt in catches. While during 1995-96, the total landing of mirror carp was 3 tonnes with average weight of 7.4 kg., each, the total catch increased to 17 tonnes with average weight of 1.5 kg each. This obviously was the result of intensive stocking of this species. Mahseer has kept a steady profile in terms of average size in the reservoir. For the last 24 years the average size ranged from 1.1 to 1.7 kg, while the total landings fluctuated between 59 to 90 tonnes during 1995-96 to 1999-2000 and the average weight of Mahseer was 1.3 kg each. The average weight of other species encountered in the reservoir viz., *L.dero, W.attu, Channa* species were 0.4, 3.8 and 1.4 kg respectively. The average weight of *M.seenghala* was 1.3 kg which decreased to 0.9 kg. during 1999-2000.

Proportion of Herbivorous and Carnivorous Fishes

Following data show the proportion of herbivorous and carnivorous fishes in terms of weight and percentage during the last five years.

During the year 1999-2000, there was decrease in the percentage composition of carnivorous fishes from 80% to 77% and an increase in total production. These obviously indicate the positive results of stocking.

Sr.No.	Year	Herbivorous fishes		Carnivorous fishes	
		Wt.(mt.)	percentage	Wt. (mt.)	percentage
1.	1995-96	80.2	24	249.5	76
2.	1996-97	92.0	23	305.3	77
3.	1997-98	88.4	21	326.4	79
4.	1998-99	72.4	20	287.4	80
5.	1999-2000	102.3	23	350.8	77

There are 14 fishermen's cooperative societies working in Pong reservoir. Marketing of fish is being done by cooperative societies through open auction system. Probably fish of Pong reservoir fetches the highest price in the country which can be attributed to the quality of the catch and open auction system adopted. The minimum and maximum rates obtained by the fishermen during

Sr.No.	Year	Summer rates	Winter rates
1.	1995-96	25.00-30.00	35.00-40.00
2.	1996-97	33.00-38.00	43.00-50.00
3.	1997-98	33.00-39.50	44.00-53.00
4.	1998-99	34.00-42.00	45.00-57.00
5.	1999-2000	34.00-43.00	45.00-59.00
6.	2000-2001	34.00-46.00	45.00-62.00

last five years are given in the Table given below.

Employment Generation

A scheme has been initiated by the Chief Minister of Himachal Pradesh for generating employment opportunities to the unemployed. Under this scheme every year some interested unemployed youth are being enrolled in the fishermen's Cooperative Societies and they are then issued fishing licences to earn money by conducting fishing in the reservoir. Employment opportunities provided under this scheme during the last five years are as under:

Sr.No.	Year	No.
1.	1995-96	*
2.	1996-97	167
3.	1997-98	163
4.	1998-99	102
5.	1999-2000	174
* Scheme not started		

Seed Stocking

The seed stocking programmes in Pong reservoir were initiated during 1974-75, when the first consignment of 1.30 lakh fry of mirror carp was released. Since then regular stocking is being done. Stocking has been mainly confined to the seed of Mirror carp and Indian major carps, *L.rohita, C.catla and C.mrigala*. The seed of other species viz., *T.putitora*, *Schizothorax* spp. and *L.dero* could not be stocked due to the absence of large-scale seed production technologies. The State Fisheries Department has set up improvised four fish seed farms located near the reservoir site, namely Kangra, Deoli, Gagret and Nalagarh. Fish seed stocking done in the reservoir during the last six years given in the Table at the bottom of this page.

Fish Yield, Catch Efforts

An analysis of production figures for the last 24 years indicates that there is consistency in yield rate which works out to 30 kg/ha. The yield ranged between 6 to 53 kg/ha. The average yield during 1999-2000 was 29 kg/ha.

Revenue

While the fish landings of Pong reservoir have shown a consistency during the last two decades, the value of fish caught has increased significantly, mainly attributed to quality of the catch. The value of fish caught increased from Rs.5.18 - 218.3 lakhs. During 1995-96 the value of fish was Rs. 112.7 lakhs, whereas during 1999-2000 fish worth Rs. 218.3 lakhs was harvested from the reservoir.

General Remarks

The Pong reservoir depicts a good example of using a reservoir for food production and generating employment avenues. Fisheries development in Pong reservoir has helped in settlement and providing livelihood to families uprooted due to impoundment. Though primarily formed for power generation, flood control and irrigation purposes, approximately 10,863 mt of fish was harvested since the inception of this reservoir. The annual yield varied from 98 to 797 tonnes per year. Among the positive decisions taken by the department, the most important was to stock the reservoir with seed of Indian major carps. This helped in the establishment of *L.rohita*, contributing as high as 42.5% of the catches during 1989-90. The amendment to State Fisheries Act 1976 (Act No.16), enforcement of mesh regulation, organisation of fishermen under the cooperative fold, promulgation of closed season, settling of fishermen during the initial stages from outside the State, initiation of fishermen's welfare schemes etc. were other well conceived measures which helped in boosting the reservoir fisheries activities and providing vocation to the displaced inhabitants of the reservoir.

Sr.No.	Year	C.carp	L.rohita	C.catla	C.mrigala	IMC. Mix	Total
1.	1995-96	3.30	-	-	-	-	3.30
2.	1996-97	3.00	-	-	-	-	3.00
3.	1997-98	1.44	9.35	1.00	-	-	11.79
4.	1998-99	2.25	8.10	2.00	-	-	12.35
5.	1999-2000	2.50	6.00	1.00	-	2.50	12.00
6.	2000-2001 (upto 15-9-2000)	1.00	8.23	2.25	-	2.45	13.93

Endangered turtles located in West Bengal

Five tiny endangered turtle species were located for the first time in a water body in Cooch Behar district of West Bengal. They have a new home now in an aquarium at the Raj Palace garden. The fishermen who had cast their nets at 'aukibeel' in Babughat village found one of the turtles among their catch recently and after search found another four.

These turtles, (*Kachuga sylhetensis*) are among the ten most threatened chelonians of oriental origin. They were identified by the Additional Forest Officer of the district, Mr. Siddharta Ray, it is reported.

Kachuga sylhetensis of the emydidae family is a critically endangered species with 90 per cent decline in population during the last decade, it is reported.

These turtles, olive brown in colour, and about 6 cm to 9.5 cm in length, have an elevated carapace with the third vertebral scute ending in a spike.

General Aspects of Fisheries Development and the Scenario in Andhra Pradesh

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Fisheries, of late, have assumed a greater role in fighting protein malnutrition. In consonance with this, a focal thrust is being given to Fisheries development by the governments both at State and Central levels.

The world trade in sea food is about $ 51 billion and India's contribution to it is $ 1.3 billion. Fisheries of India contribute to 5.2 million tonnes of fish combinedly from marine and inland areas (2.85 million tonnes from marine and 2.34 million from inland). By and large, the fisheries sector of India tends to be dominated by small scale coastal fishing. This situation has presented a challenge for responsible management of natural water resources for securing sustainable production. Natural water resources are aplenty and their effective management and utilisation in an eco-friendly and sustainable way is a challenging task for all concerned.

With the evolution of Agriculture and Animal Husbandry as major concerns of governments world over, the relative importance of fish as a protein provider had been receding, despite the fact that animal protein sources of aquatic origin still remain crucial to human health in many parts of the world. On an overall global scale, fish and fishery products make up 16% of animal protein intake. Fish accounts for 70% of the animal protein in the diet of many people from developing countries.

Even though agriculture is the mainstay of India, the implications of WTO agreement pose a major hindrance to the agricultural farmers in getting good returns. In this scenario, aquaculture and capture fisheries offer an ideal alternative to agriculture. However, in the absence of responsible management of fisheries resources involving sustainable fishing, some of the fishes may soon become a rare commodity.

Due to growing uncertainties in the capture fisheries as a result of over fishing and destruction of spawning grounds, emphasis should rightly be on aquaculture as a viable alternative to meet the increasing demand of fish. There are several avenues for increasing fish production through aquaculture. Examined objectively, however, we must recognise that the number of aquatic creatures that have culture potential are far greater than the number of land animals that man relies on to satisfy his food needs. Compared to the land environment, our oceans, rivers and lakes contain far greater diversity and therefore far greater potential as a source of protein. The challenges of harnessing this potential are also much greater, since man has less of familiarity with aquatic potential for food production than his knowledge and association with land for raising food crops. Despite these challenges, aquaculture today is a rapidly growing part of agriculture. Aquaculture is not only a rapidly expanding industry, but also one that continues to offer vast opportunities. Aquaculture can be used as a tool to upgrade the quality of life of the rural population through a direct impact on their socio-economic status. Extensive aquaculture is one of the best means of ensuring diversification of land and water use, providing employment, and generating income for the sections of rural poor of the society. While propagating viable aquaculture technology, the relationship between society and technology has to be assessed to continuously reorient the technology relevant to techno-socioeconomic status of the targeted population.

Due to high returns and less of man power involvement in aquaculture, in comparison with any agriculture business for unit land holding, culture of fish and prawn has gained importance in the last few years. The State of Andhra Pradesh has plenty of water resources with a tremendous potential for development of fishery wealth. The State holds the first position among the various maritime States in Coastal Aquaculture, and occupies in the country the second slot in inland fish production and 7th position in marine fish production. In Andhra Pradesh, as far as freshwater fish farming development is concerned, there are over 74,000 no. of tanks with a waterspread area of 6.23 lakh hectares, found suitable for fish culture. In addition, around 90,000 hectares of waterspread is under exclusive fish farming. Around 78,700 hectares of brackishwater lands have been brought under shrimp farming, fetching about Rs. 2000 crores of foreign exchange to the country.

In respect of the contribution of fisheries sector to the Gross State Domestic Product, an indicator of development, Andhra Pradesh stands Second in the country, behind West Bengal and followed by Tamilnadu.

Owing to availability of bountiful resources, the State Government has recognised fisheries as one of the growth

engines while drawing up plans for Swarna Andhra Pradesh in Vision 2020 document. And in this direction, the Fisheries department is going ahead with proactive measures in the development of fisheries in the State. The fish seed production had been stepped up by over 300% during the previous year to enable the stake- holders to take up stocking of water sources with quality fish seed, thereby heralding productive utilisation of water sources for increased fish production. The department is giving thrust to diversification of culture species and this is well illustrated by Scampi (fresh water prawn) culture taken up in more than 15,000 hectares in the State. Awareness camps and aqua clubs are being popularised to bring in awareness and collective approaches for management of brackishwater farms and tackling problems associated with environment, disease treatments etc., Disease diagnostic laboratories are being established at central locations for containing the spread of disease among fish/shrimp/prawn under culture in the farms, besides attending to the needs of the farmers in extending guidance in disease free, sustainable farming practices. The Government have enacted Marine Fishing Regulation Act for regulating marine fishing, under which ban on fishing is slapped during the spawning season to allow natural production of marine fishes generally unhindered. Artificial reefs have also been installed at five locations in an effort to increase fish catches in the nearshore waters of the State. These are some of the measures already initiated for increasing the fish production in the state.

In this background, and keeping the challenges in view, the government have accorded high priority to fisheries development in the State.

While there are vast areas in the State that can be brought under aquaculture, effort to spread aquaculture need not be restricted to land-based aquaculture. Many other exciting prospects are there. One of these is on the capture side by stock enhancement. Biotechnological breakthroughs have opened up many new doors for aquaculture research. In fact, aquaculture is a very young field with so many eco-friendly systems such as cage culture unexplored and with so much potential to be availed of and with a vast scope for innovation in the country.

Andhra Pradesh Scenario

The Govt. of AP has prepared a Vision document called the "Vision 2020". It has been identified that fisheries have a tremendous potential and as a growth engine under Vision 2020. It is visualised that fish production will be four times its current level, reaching 10 lakh tonnes a year by 2020. The sector will generate thriving, diversified exports and provide ample stocks of highly nutritious food to the people of Andhra Pradesh and other States. Five initiatives have been identified in this regard as given hereunder :

* Develop the fisheries value chain and boost exports
* Create and promote investment in infrastructure for the development of fisheries
* Ensure the setting up of Institutions to build skills
* Ensure sustainable development
* Promote the welfare of the State's fishing community through investments in housing, education and wealth.

Because of the various steps taken by the Government of A.P. through the Department of Fisheries the target of 10 lakh tonnes envisaged by vision 2020 are expected to be achieved by 2010 itself.

Based on the present trends and the action plan envisaged, the targets proposed under Swarna Andhra Pradesh in fisheries sector are as follows :

The strategies and policy interventions identified to achieve the goals in fisheries sector are as follows:

In Inland Fisheries:

* Increasing the rate of fish production in tanks from 750 kg/ha to 1800 kg/ha, in Reservoirs from 30 kg/ha to 150 kg/ha an in ponds from 1500 kg/ha to 3000 kg to 5000 kg/ha gradually:
* New approaches in stocking of fish seed.
* Diversification for stocking alternate cultivable species like Giant Freshwater Prawn.
* Reservoir fisheries development by stocking of fingerlings, Introduction of cage culture etc., and
* Adopting effective extension services and enacting comprehensive legislative and regulatory measures

In Marine Fisheries:

* Progressive motorisation of tradition crafts, replacement of wooden crafts with FRP crafts.
* Effective Shore to Vessel Communication system with Radio towers on the shore and through VHF sets given to the Boat operators.
* Enforcing mesh regulation, responsible fishing by fishermen and observing closed season.
* Strengthening modern fishing methods with improved designs of craft & tackle, through use of satellite data for forecasting fish movements, providing orientation on exploitation of offshore pelagic fishing and organised development of fishing harbours and more hygienic landing centres.

Targets for Fish/Shrimp during 2000-01 to 2019-2020

S.No	Source of	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2019-2020
1.	Inland fish	3.60	4.05	4.50	5.45	5.70	5.80
2.	Marine fish	1.55	1.95	2.35	2.75	2.95	3.20
3.	Shrimp/prawn	0.65	0.70	0.75	0.80	0.85	1.00
	Total	5.80	6.70	7.60	9.00	9.50	10.00

In Brackishwater Fisheries:

* Development of culture systems for alternate species like Sea Bass, Crab etc.,
* Adopting traditional/improved traditional methods of shrimp culture,
* Control on seed by enacting Aqua Seed Act and enforcing Coastal Aquaculture Regulation,
* Establishment of Disease diagnostic laboratories, and
* Promotion of Aqua clubs and conducting awareness camps.

The Welfare of fishermen communities will be given importance by undertaking schemes for providing pucca houses to fishermen with unit cost enhanced, refining Group Accident Insurance scheme with exgratia amounts enhanced, adoption of Relief-cum-savings scheme to marine and inland fishermen including fisher women, adequate health care and educational facilities etc.,

Future Approach

Looking at the problems faced by the Fisheries Sector, though it is able to contribute more than 2.26% to the GSDP, the encouragement given and the infrastructure provided by the State or Central government to facilitate development of Fisheries in the State is very inadequate. Riddled with deficient road network that impedes quicker transportation, inadequate marketing knowledge and deficient animal health-care coupled with lack of insurance coverage, and with practically no financial assistance extended to aquaculture, this sector is bound to have many obstacles to bring about quantum changes. The Governments both at Centre and State should be able resolve the problems and pave the way for stepping up the tempo of development.

Besides the above requirements to be fulfilled by the Governments, the aquaculturists themselves should conform to a code of conduct, that stipulates the best practices, taking care of environmental considerations of other human activities and also ensuring the utilisation of minimum quantities of water by recycling the used water, if necessary, as water scarcity might be another problem that may be faced by the aquaculturists in course of time.

In fact, the approach for the next Millennium should be that of a conservation, associated with exploitation, sustainability in production and also eco-friendly approaches, keeping the social needs in mind.

Besides the above, there is an urgent need to integrate the efforts made through research and development, the knowledge of educational institutions and also the field experiences of the Departments dealing with the development of fisheries.

Conversion of own paddy fields for aquaculture illegal

Mr. Justice B. Sudershan Reddy of the AP High Court is reported to have delivered a judgement recently that the authorities are duty-bound to interfere and stop activities such as aquaculture to prevent damage to the irrigation systems and common resources.

The judge is stated to have refused to come to the rescue of aquaculturists who had set up prawn ponds in their own lands near an irrigation tank of Krishnapatnam, Nellore district.

The court was dismissing a batch of writ petitions filed by several persons, complaining against interference by the authorities. They claimed that the activity was taken up in their own lands in the tank area and sought a direction restraining the authorities from interfering with the aquaculture.

The allegation of the petitioners was that the District Collector had inspected the lands and ordered action contrary to the law. Initially, interim orders were passed in favour of these aquaculturists. A separate writ petition was then filed by a farmer complaining that the irrigation tank was occupied by some persons and they had raised bunds for setting up prawn ponds within the tank bed and the authorities were not taking action to lend protection from the act. The irrigation authorities submitted records to show that the tank had been in existence for the last 50 years and that there was a large ayacut. The revenue officers produced the inspection report of the District Collector and the reports of the A.P. Pollution Control Board.

Mr. Justice Sudershan Reddy said that the court appreciated the action of the District Collector, who had heeded to the complaints of the farmers. He made it clear that "may be they are owners of the lands but they cannot be permitted to indulge in any activity adversely affecting the very existence of the irrigation system and the tank itself."

"These alleged owners of the lands which fell within the tankbed were free to cultivate lands when they were not submerged, but cannot resort to aquaculture," the judge said.

Referring to the report of the Pollution Control Board, the judge asked: "Can this court pevent the authorities from interfering in the matter with a view to stopping the ongoing macabre drama enacted by aquaculturists?. The court referred to the Supreme Court judgement regarding prawn culture and said that the conversion of the tankbed into prawn ponds was contrary to the Supreme Court judgement, and said that any order to prevent the authorities from acting will amount to compelling the authorities to act contrary to the apex court judgement.

PROTEST AGAINST AQUACULTURE BILL

Reports speak of massive efforts on the part of various fisheries associations to stage a massive protest against the coastal aquaculture authority bill proposed for introduction in the parliament soon.

Fisheries Development in Assam

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The State of Assam is situated in the Eastern Himalayan region between 24° N and 28°.18' N latitude and 89° E to 97° 4' E longitude. Geographically, the State may be divided into three distinct regions viz., (1) Northern plain known as the Brahmaputra valley bordered by sub-Himalayan mountain range of Bhutan and Arunachal Pradesh in the north and east, Nagaland Hills in the east and south east and hills of Meghalaya in the south west. The valley is bisected by the mighty river Brahmaputra from east to west, (2) The southern plain of the Barak Valley is again surrounded by the Barail hill range in the north, hills of Manipur in the east, hills of Mizoram in the south and Tripura hill region in the west. This plain is again bisected by the river Barak from east to west. Both the river systems are fed by a network of tributaries which debouch huge volumes of water from a vast catchment area, (3) The third region comprising the two hill districts of Karbi-Anglong and North Cachar stand between the two plains. Agro-climatic conditions of the State are such that the soil and water are both acidic with pH of water ranging from 5.5 to 6.5, annual rainfall between 1500 mm to 4465 mm and water temperature ranging from 15° c to 35° c. Assam is one of the heaviest rainfall areas of the World and floods are almost a regular phenomenon every year in some parts or the other of the State.

Production and Demand

The present annual fish production from all sources is about 1.60 lakh tonnes as against the demand of 2.50 lakh tonnes, thus leaving a gap between supply and demand. The demand is likely to go upto about 3.20 lakh tonnes in this decade. The deficiency in production within the State is partially met by importing fish to the tune of around 0.25 lakh tonnes annually by private traders from other States like Andhra Pradesh, Uttar Pradesh, West Bengal and Bihar, which causes an outflow of an amount of around Rs. 100.00 crores annually from the State.

Water Resources

The State is rich in fishery resources of varied types. The category-wise resources are summarised below :

Type	*Extent (ha)*
1. Riverine Fisheries	2,05,000
2. Beel/ Ox-bow lakes	1,00,000
3. Forest Fisheries	5017
4. Derelict water bodies/swamps	10,000
5. Reservoir Fisheries	1713
6. Ponds/ Tanks	25,423
Total	3,47,153

Note: *Combined length of rivers - 4820 Km, with area of about 2.05 lakh ha; Fish production in 1999-2000 was 1,60,000 t; and Fish production includes production from rivers also.*

Aquaculture plays an important role in the of the State economy. It also provides livelihood to thousands of people directly or indirectly. The gross value of fish production in the State has been estimated to be around Rs. 620 crores. The vast water resources of the State has the potential to render it into a surplus State in respect of fish production. The District-wise water resources and fish production are shown in Table I.

Fish Production : Present Trend

Seed: The State has attained self-sufficiency in carp fry production. However, the production of fingerlings (125-150 mm) is yet to be achieved in various parts of the State to the needed extent to facilitate stocking in tanks, ponds etc., at the onset of culture season. Fish Seed production in the State was 2114.14 million fry during 1999 - 2000. This comfortable position was achieved due to commissioning of 61 Nos. of ecohatcheries and nine minibundhs in the State, majority being in the private sector. The Districtwise seed production along with infrastructure available is furnished in Table II.

The scenario of production of seed of live-fishes is not at all encouraging at present. For this reason, culture of live-fishes in the State has not yet made any dent. To meet the growing demand of seed of live fishes, mainly of Magur, four Magur Breeding Centres were established in the State during 1997-98 under World Bank assisted ARIASP programme for research purposes. Prawn culture in the State is proposed to be initiated with seed to be brought from West Bengal.

Fish: The State achieved a fish production level of about 160,000 tonnes during 1999-2000. This includes fishes of all varieties from all types of water resources. The productivity of carp fish in culture ponds crossed the target of 3000 kg/ha/yr., in several cases, with the average of nearly 2000 kg/ha/yr. In capture fisheries, present productivity in beels is in the range of 80-100 kg/ha/yr., with the scope to enhance it to a level of 500 kg/ha/yr. or more. 36 nos. of beels covering 4572 ha of water area have been developed under World Food Programme from 1987-'88 to 1996-97 with a production level of over 300 kg/ha/yr. Natural productivity in some of the beel fisheries has gone down due to obstruction to auto-stocking because of silting up of link channels (with the river) due to construction of flood control bundhs. All environmental factors are taken into consideration at the time of development of beels under World Bank programme. Riverine fish production is in the range of 50 kg

Table 1. Districtwise Water Resources and Fish Production in Assam

Sl. No.	District	Ponds/Hanks (ha)	Beel/Swamp Low-lying area (ha)	Total (ha)	Fish production (mt) (1997-98)
1.	Nagaon	3910.00	16532.40	20442.40	13065.16
2.	Barpeta	1659.71	6764.80	8424.51	9956.95
3.	Goalpara	754.49	10487.29	11241.78	5873.83
4.	Lakhimpur	621.03	5255.97	5875.00	5732.00
5.	Sonitpur	1226.69	7390.45	8617.14	5802.51
6.	Tinsukia	182.82	3907.27	4090.09	7775.12
7.	Dhemaji	270.00	7015.98	7285.98	3857.70
8.	Cachar	3200.00	4812.58	8012.58	9790.20
9.	Nalbari	2245.19	2863.83	5109.02	8766.10
10.	Dhubri	726.36	7287.42	8007.78	10088.81
11.	Darrang	2008.00	6092.37	8700.37	6089.10
12.	Sibsagar	956.27	5068.31	6024.58	5570.10
13.	Jorhat	289.30	6778.98	7068.28	6488.32
14.	Hailakandi	1261.69	2103.05	3364.74	5485.88
15.	Dibrugarh	125.73	4755.85	4881.58	7870.00
16.	Golaghat	795.33	2819.21	3114.54	4178.55
17.	Kokrajhar	451.93	913.50	1365.43	4150.30
18.	Morigaon	587.14	2955.96	3543.10	6892.50
19.	Kamrup	1500.00	1607.16	3107.16	9985.00
20.	Karimganj	2267.26	4310.44	6577.70	9470.97
21.	Bongaigaon	330.35	1758.09	2088.44	5243.00
22.	Karbi-Anglong	503.07	97.18	600.25	2245.20
23.	N.C.Hills	51.45	1725.87	1777.32	755.40
	Total	**25423.81**	**113295.96**	**138719.77**	**155132.80**

ha/yr. Indiscriminate killing of brood fish and juveniles by use of prohibited nets has reduced the river productivity in recent times.

Attempts are underway to achieve maximum sustainable yield (MSY) in such natural water bodies.

Fisheries Development in 9th Plan

There are nine fisheries schemes under the ninth plan. The Schemes for the benefit of Scheduled Caste and Scheduled Tribe people have been greatly affected during 9th plan period due to insufficiency of plan funds under Scheduled Caste Component Plan and Tribal Sub-Plan.

Out of the approved 9th plan allocation of Rs. 9425 lakhs (except Hill Plan) the cumulative revised allocation for the first four years of 9th plan was Rs. 4713.60 (Non-EAP = Rs. 2056.50 lakhs and EAP = Rs. 2657.10 lakhs). Against this revised allocation, the cumulative expenditure is Rs. 4076.37 lakhs (actual for 1997-98 to 1999-00 and anticipated for 2000-01). Salary expenditure alone was 90.94% and 93% of the plan expenditure during the year 1998-99 and 1999-2000 respectively under NON-EAP sector.

The main development programmes along with approved 9th plan allocation, Annual plan allocation, expenditure, and physical target and achievement are mentioned below :

Aquaculture Development under Fish Farmer's Development Agency (FFDA) : There are 23 FFDAs in the State. Pattern of funding for the development component under this Centrally Sponsored Scheme was 50:50 between Govt.of India and State Govt till 1999-2000. This has been enhanced to 75:25 between Govt. of India & State Govt in 2000-2001.

Though there is enough scope to develop existing ponds covering over 25,400 ha. and create new ponds in low-lying areas having a potential of about 20,000 ha, required level of progress could not be made due to provision deficiency in the State's matching share. This resulted in non-availing of Central share fully under the Scheme. During 9th Plan, 200 ha. of water area had been developed.

Development of Derelict Water Bodies: The State is having over 10,000 ha. of derelict water bodies with potential for conversion into pond/tanks for fish culture. During 9th plan 127.50 ha of derelict waters had been developed for fish culture.

National Welfare Fund for Fishermen: This is a Centrally Sponsored Scheme to construct low-cost houses, to provide tube-well and community hall for poor fishermen in selected villages with 50:50 share of expenduture between Govt. of India and State Government. 20 houses could be constructed during 9th plan under the scheme.

Development of Beel Fisheries: The State has one lakh ha. of beels (lake and open water fisheries) which constitute about 12% of country's wetlands. The Department of Fisheries, Assam developed 4573 ha. under World Food Programme during 8th plan and another 5500 ha. is under process of development through World Bank-aided Assam Rural Infrastructure and Agricultural Services Project. This is likely to be completed during 9th plan. There remains an area of about 90,000 ha, which has the potential to contribute atleast 90,000 t. of fish annually, but awaiting development. At present, the beels yield an annual production of 24,205 t. Beel fishing development in ninth plan is expected to cover 4676 ha of area.

Fish Seed production: The State has achieved self-sufficiency in seed (Fry) production mainly through involvement of private sector. However, it is felt that the quality of the seed could be stepped up further by taking effective steps for controlling inbreeding through elimination of undersized broodstocks utilised for breeding at private farms.

Table - II Districtwise Seed (Fry) Production and Availability of Infrastructure in Assam

Sl. No.	*Distict*	*Eco Hatchary (No)*	*Hapa breeding centre (No)*	*Mini bundh with portable Hatchary (No)*	*Seed Production (Million) (1997-98)*
1.	Dhubri	-	04	01	4.68
2.	Kokrajhar	-	-	-	nil
3.	Bongaigaon	01	-	-	15.51
4.	Goalpara	-	06	-	2.90
5.	Barpeta	06	16	01	198.67
6.	Nalbari	03	11	-	153.09
7.	Kamrup	01	02	01	0.29
8.	Darrang	-	-	01	6.93
9.	Sonitpur	02	13	01	20.23
10.	Lakhimpur	03	10	01	70.47
11.	Dhemaji	-	11	-	0.97
12.	Morigaon	02	-	-	6.08
13.	Nagaon	33	-	-	1452.85
14.	Golaghat	01	03	-	8.20
15.	Jorhat	-	03	-	16.20
16.	Sibsagar	03	-	01	18.35
17.	Dibrugarh	01	01	01	17.71
18.	Tinsukia	01	05	-	8.54
19.	Karbi-Anglong	01	02	-	1.77
20.	N.C. Hills	-	-	-	0.09
21.	Karimgang	02	104	-	163.25
22.	Hailakandi	01	14	-	67.67
23.	Cachar	-	15	01	11.12
	Total	**61**	**220**	**09**	**2245.57**

(Seed Production in 1999-2000 was 2114 million).

In this context steps are afoot to demonstrate upgraded breeding practices at the seed farms of the government through development and creation of additional infrastructure and fuller utilization of existing manpower. These farms will be Centres of 'Quality' Seed Production for distribution among seed producers for raising quality broodstocks for raising quality seed for higher fish production. Presently, about 85 developmental Fish Seed Farms out of about 142 are under lease with private entrepreneurs, who are expected to utilize the full potential of the farms in the coming years.

Extension and Training: Extension support/transfer of technology to farmers is a grey area in the State, as is the case in several other States. Greater financial allocation under this scheme is expected in the tenth plan for providing field-oriented training to farmers, for conducting Seminer/Workshops etc.

The Central Sector Scheme on Fisheries Extension and Training could not take off in the ninth plan due to fund constraint. (20% of State's share under the Scheme could not be provided).

***Fishery Survey and Collection of Statistics*:** This is a State Plan Scheme. This Scheme is vitally important as the availability of up to date statistical information on fishery development is an essential input for monitoring the implementation of various schemes. The Survey work under the Scheme could not pick up momentum during the ninth plan. There is hope that it will be implemented during tenth plan with provision of adequate funds.

The physical targets and achievements along with 9th plan approved outlay under the ARIASP development programme, Assam Rural Infrastructure and Agricultural Services Project (ARIASP) are furnished in Table III. Particulars of fish and fish seed production during the ten-year period from 1990-91 to 1999-00 are given in Table IV.

Basis of assessment of Fish Production

The present level of fish production is the State is 1.60 lakh mt (1999-2000) against the 9th plan (terminal year) target of 1.75 lakh mt. The average annual increase in fish production of the State during last 3 years of 9th plan is 1%. This limited increase in production is attributed mainly to the absence of adequate extension support to farmers and inadequate coverage of water area for development under Government sponsored Schemes. The targeted coverage of water area under World Bank Aided (ARIASP) programme is the only development programme under implementation by the Department at present which covers 4% total pond and tank area for fish production and 5.5% of total beel area of the State.

The State has a production potential of 4.04 lakh mt of fish annually, against which the achievement now stands at 1.60 lakhs, as already stated. Increased investments in the fishery sector for allround development are considered necessary to reach a sustainable level of annual fish production and for the fisheries sector to reach a position comparable to other sectors.

Constraints in increasing the fish production and productivity of different waters

The present level of average culture fish production under extensive system from ponds and tanks now stands at 1000 - 1200 kg/ha/yr. in Assam. Semi-inten-

Table - III. Statement showing the Physical Targets & Achievements (1995-96 to 1999-2000) under Fishery Sector (ARIASP)

Sl. No.	Name of the Scheme	Units	Target	Achievement					
				1995-96	1996-97	1997-98	1998-99	1999-2000	Progressive total
1.	Development of	Ha	200	55.63	57.65	50.00	184.46	347.74	Farmers Pond
	No			220	222	308	1410	2160	
2.	Dev of Community	Ha	300		90.53	92.02	80.00	222.82	485.37
	Tank				57	51	56	164	328
3.	Pig cum Fish	Ha	31.25	6.25	6.25	6.25	6.25	6.25	31.25
	culture	No	125	25	25	25	30	32	137
4.	Fish cum		62.5		11.02	22.70	20.00	10.50	64.22
	Horticulture	No	250		44	84	85	71	284
5.	Paddy cum Fish	Ha	24			6.00	6.00	12.00	
	culture	No	60				21	16	37
6.	Dev of Beel	Ha	5000			783.00	1172.00	1955.00	Fisheries
7.	Dev of Open Water	Ha	500				194.00		194.00
	Fisheries								
8.	Officers training	No	200		36	38	34	7	115
9.	Earmers training	No	1400		200	200	500	1693	2593
10.	Civil works &	Unit	6		2	4		6	
	Training centers								
11.	Renovating of	Unit	2		2				2
	Training centers								
12.	Eco-hatchery	Unit	1			1			1
	Complex								
13.	Wet laboratory	Unit	2			2			2
14.	Magur breeding Unit	Unit	5			4			4
15.	Mini Fish Feed Plant	Unit	1			1			1
16.	Procurement of	Set	2						0
	Scientific equipment								
17.	Procurement of Aud-	Set	13						0
	io visual equipment								
18.	Procurement of	No	28		16	3			19
	Vehicles								
19.	Research projects	No	5			5			5
	AMC & CDF								

sive farming practices are yet to be taken up by Assam farmers at a significant level. The main constraints identified to bring about improvements in culture systems are :

a) Lack of proper extension support due to fund contraint and inadequate extension staff at field level.

b) Non-availibility of standard size, quality fish seed in proper proportion and in proper season.

c) Scarcity of fish feed and also its high cost.

d) Fish culture continues to remain, by and large, as a traditional practice.

In the case of capture fisheries like Beels the vast potential has to be harnessed. The present level of productivity is only in the range of 100-120 kg/ha/yr against the potential of 750 - 1000 kg/ha/yr. The main constraints in the way of realising the potential are :

a) Capture fisheries are mainly practiced in beel

Table - IV. Fish and Fish Seed Production in Assam for Last Ten Years

Year	Fish Seed (nos./million)		Fish (in 1000 t)	
	Target	Achievement	Target	Achievement
1990-91	140.00	1188.60	75.00	76.02
1991-92	135.00	1215.14	85.00	134.07
1992-93	1500.00	1626.32	140.00	140.60
1993-94	2000.00	2170.81	142.00	151.60
1994-95	2000.00	2386.79	145.00	153.00
1995-96	2400.00	2547.54	148.00	155.00
1996-97	2500.00	2634.38	153.00	154.60
1997-98	2600.00	2245.57	157.00	155.10
1998-99	2600.00	1703.06	157.00	155.70
1999-00	2600.00	2114.14	157.00	159.77

MAIN AREA-SPECIFIC NEEDS FOR THE DEVELOPMENT OF FISHERIES SECTOR OF ASSAM.

THE SPECIFIC FELT-NEEDS IN THRUST AREAS FOR THE DEVELOPMENT OF FISHERIES IN THE STATE ARE AS FOLLOWS :

Culture Fishery in ponds and Tanks	1. Introduction of a network of fishseed distribution system under joint management of Private and Govt. sector. 2. Establishment of Fish Feed Plant. 3. Recruitment and creation of 86 posts of Fishery Extension Officers, one post in each of the 86 development blocks where there is no field level technical staff at present. 4. Provision and release of required fund for extension services.
Beel Fisheries	1. Formulation of a broad integrated beel fishery programme with a long term strategy. 2. Provision of required fund on regular basis to implement the programme.
River Fishery	1. Formulation of a broad National River Fisheries Management Programme covering all the related aspects and its implementation.

fishery.

b) Large number of beels are infested with aquatic weeds, and weed fishes.

c) Unscientific management leading to gradual siltation of the beel fishery.

d) Granting leases of beels for a short duration, leading to total exploitation of the fishery in a non-sustainable manner.

Fish production in rivers at present is in the range of 20-25 kg/ha/yr. This level of poor production is attributed to the following reasons :

a) Indiscriminate killing of brood fish and juveniles through use of prohibited nets, and disregard towards provisions in Fishery Acts and rules.

b) Siltation of river beds impart a blanketing affect on the productivity of rivers.

c) Construction of bundhs and sluice gates along the river courses which cause destruction to spawning and nursery grounds of all the commercially important species thereby reducing the natural recruitment.

d) Siltation of river bed due to large scale deforestation in the catchment area.

e) Adverse effects of industrial pollution/ effluents causing mortality of fish in the river systems.

Suggested measures to overcome the identified constraints/ problems

a) Pond and Tank Fishery

1. Provision of required funds for extension services related to field programmes and creation of minimum posts of technical personnel needed in the field.

2. Increasing seed rearing area under private sector and adoption of a suitable fish seed production policy.

3. Full utilization of the potential of seed farms under Department of Fisheries/ Fish Farmers Development Agency.

4. Establishment of a network of fish seed distribution system under a joint management system by State fisheries department and private sector for ensuring timely supply of standard quality and quantity fish seed to the fish farmers.

5. Establishment of fish feed plants in the State on Zonal basis.

6. Provision of short duration hands-on training to the majority of farmers annually at district level.

7. Organising easy flow of funds to farmers for fishery development and for creation new infrastructure and improving existing infrastructure.

8. Regular visit of departmental officers and progressive farmers to the farms in States like Andhra Pradesh, West Bengal etc.

9. Leasing out of low-lying area/tanks under State ownership to the unemployed fisheries graduates for their self employment.

b) Beel fishery

1. Formulation of a broad beel fisheries development programme for implementation in the State with an integrated approach so that large beels can be utilized as fish production cum irrigational units and small beels for semi-intensive farming.

2. Conducting awareness campaign amongst fishing community about the drawbacks of present fishing systems and about improved fishing methods and their impact.

3. Bringing of fishermen's co-operative societies under the umbrella of State Fisheries Department.

4. Adoption of a policy for long term leasing of government-owned water bodies for a duration of 10-15 years, and

5. Encouraging unemployed fisheries graduates in taking lease of beel fisheries for their gainful employment.

c) Rivery Fishery

1. Strictly following fishery Acts and Rules.

2. Promulgation of a new law and amendment to existing fishery rules prevailing in the State.

3. Formulation of a broad National River Fishery Management Programme covering all related aspects.

4. Declaration of Sanctuaries Protection of breeding and nursery grounds etc.

Prospects of Fisheries Development in Chhattisgarh State

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Madhya Pradesh was created in 1956 after merging States of Madhya Bharat, Vindhya Pradesh, Bhopal and part of Mahakosal area. Now after 35 years, Madhya Pradesh has been split leading to the birth of Chhattisgarh State on 31.11.2000, with its capital at Raipur. The new State includes erstwhile districts of Raipur, Bilaspur, Durg, Rajnandgaon, Sarguja and Bastar. Before the formation of the new State sixteen districts were formed by splitting seven larger districts (old) as given in Table I.

Table I

Old Districts	*New Districts*
1. Raipur	1. Raipur 2. Dhamtri 3. Mahasamund
2. Rahnandgaon	4. Rajnandgaon 5. Kwardha
3. Sarguja	6. Sarguja 7. Bakunthpur
4. Raigarh	8. Raigarh 9. Jashpur
5. Bastar	10.Jagdalpur 11.Kanker 12.Dantewara
6. Bilaspur	13.Bilaspur 14.Korba 15.Janjgir
7. Durg	16.Durg

Old Madhya Pradesh

Lately, old Madhya Pradesh had attained a significant position both in fish and fish seed production in the country. In one decade its fish production had increased from0.44 lakh t in 1990-91 to 1.274 lack t in 1999-2000. It became one of the ten States of the country producing fish one lakh t and above annually. However from productivity point of view it has continued to lag behind. Its annual pond fisheries productivity of 1734 kg (1998-99) per hectare was still 21.18% below the national average of 2200 kg.

Production of standard fry had increased from 300 million nos in 1990-91 to 619.5 million in nos 1999-2000. Madhya Pradesh had become one of the five States producing 500 million nos and above standard fry annually. Private sector has contributed substantially in the production of fish and fish seed. Its share in fish production was seldom less than 80%. In the case of fish seed production its share had increased from about 40% in 1990-91 to 66% in 1999-2000.

In respect of resource utilisation, old Madhya Predesh had attained 82.94% coverage by the end of 1999-2000.

The composite state, before partition, had on the east Mahanadi, Indravati etc. Narmada, Tapti and other rivers on the west and also Chambal, Betwa etc. river systems. Fish fauna comprised 180 species including bigger prawn species i.e. *Macrobrachium malcolmsonii* and *Macrobachium rosenbergii.*

Cooperatives were also well set with the registration of 1861 Fisheries Societies whose average membership was 34.34 per society. A Matsya Maha Sangh with State-wide jurisdiction also functioned apart from two federations of Dam oustees at Tawa and Bargi reservoir.

Chhattisgarh State

Resources

Physical area of the new state is 135234 km. which is about 30% of the area of erstwhile Madhya Pradesh. Resource wise the new State has inherited 37.2% of the water area available in composite Madhya Pradesh (Table III).

In the case of resource utilisation, composite Madhya Pradesh State had attained 82.94% coverage by end of 1999-2000 as shown in Table II.

Table II

Resource	*Available lakh/ha*	*Coverage lakh/ha*
Reservoirs	2.67	2.41 Lac (90.26%)
Ponds/Tanks	1.20	0.80 Lc (66.67%)
Total	**3.87**	**3.21**

Ratio of available water area to physical area of the State is higher in Chhattisgarh than what was in the composite Madhya Pradesh.

Old Madhya Pradesh - 0.87%

Chhattisgarh - 1.06%

According to available information about 84.02% of the water area has been already covered under Fisheries Development before the formation of the new State (Table III).

Fish fauna

According to available information fish fauna of Indravati and Mahanadi rivers of Chhattisgarh had been surveyed in the past. Mahandi is reported to have 110 species of fish. However, details are not available at present. Among crustaceans, *Macrobrachium malcolmsonii* is available in the tributaries of Godavari and Mahanadi.

Table III

Resource	*Available in Old M.P.*	*Available in Chhattisgarh*
Reservoir	2.67 Lac hectare	0.81 Lac (30.33%)
Ponds/Tanks	1.20 Lac hectare	0.63 Lac (52.50)
Total	3.87 Lac hectare	1.44 Lac (37.20%)
River	20661	3573 Km

Table IV

Resource	*Area Available in Chhattisgarh (lakh ha)*	*Water area covered up to March 2000 (lakh/ha)*
Reservoir	0.81	0.72 Lac
Ponds/Tanks	0.63	0.49 Lac
Total	1.44	1.21 Lac

Table V

Resource	*Requirement as per available water area*		*Requirement as per water area already covered*	
	Area	**Fish seed**	**Area**	**Fish seed**
Reservoir	0.81 lac ha	81.00 Million (@ 1000/ha.)	0.72 lac ha	72.0 million
Ponds/Tanks	0.63 lac ha	315.0 Million (@ 500/ha.)	0.49 lac ha	245.0 million
Plus 10% allowance for transit mortality	-	39.6million	-	31.70 million
Total	1.44 lac ha.	435.60 million	1.21 lac ha	348.70 million

Fish seed production

Annual Fish seed requirement in term of standard fry, as per water area in Chhattisgarh is estimated to be 435.6 million. Current requirement of fish seed is about 348.70 million.

Existing production of fish seed from Chhattisgarh area is reported to be 257.7 million standard fry (1999-2000) which is quite short of its requirement. In the past annual fish seed production in Chhattisgarh area has fluctuated between 260 to 290 million standard fry. About 60% production was contributed by the private sector.

At present there is a shortfall of about 30% between demand and the home production which will be required to be addressed by the new state.

Fish Seed Trade

A salient feature of Chhattisgarh is the existence of a well established fish seed trade at Raipur. Few traders also operate in Durg, Bilaspur and Raigrah. Fish seed is procured by traders mostly from West Bengal and supplied to fish farmers either directly or through their outlets located in Rajnandgaon, Bilaspur and Raigarh.

Traders assist in filling the gap between home production and demand of the fish farmers to some extent. But instances of malpractices are equally there whose main victims are innocent fish farmers. This aspect shall be also required to be addressed in the new State.

Fish Production and productivity

Chhattisgarh has potential for producing 1.60 lakh t fish annually from various resources under its jurisdiction.

Reservoirs @ 25 kg/ha	2000 t
Ponds/Tanks @ 2500 kg/ha	1,57,500 t
Rivers	100 t

In 1999-2000 production of fish from Chhattisgarh area was 78149 t which was 61.5% of the total production of 1.27 lakh t of erstwhile State of Madhya Pradesh. Existing average reservoir productivity of Chhattisgarh area was about 20 kg/hectare which will need lot of improvement. District level average annual fish productivity of Ponds/Tanks has ranged from 1000 to 2100 kg/hectare. Erstwhile districts of Raipur, Durg and Rajnandgaon have already attained average productivity of 2000 kg and above. In some individual cases productivity as high as 10000 kg/hectare has been also obtained.

With proper training and planned demonstration it can be possible to obtain average productivity of 2500 kg or above with in a decade.

Fisheries co-operatives/Matsya Maha Sangh

820 Fisheries Cooperatives were registered in Chhattisgarh area. Average membership per society was 27.13. After the formation of Chhattisgarh a separate Matsya Maha Sangh has been formed at Raipur. Its jurisdiction covers all those 13 reservoirs and 5 fish hatcheries located in Chhattisgarh area which were earlier under Matsya Maha Sangh, Bhopal. These hatcheries have potential for producing about 86.0 million standard fry annually. Upto 70 million standard fry has been produced from these hatcheries in the past.

About 0.36 lakh ha of reservoir area is under the new Matsya Mahasangh. This was about 44% of reservoir area available in Chhattisgarh. According to available information (93-94, 97-98) average annual fish productivity of majorty of the 0.36 lakh ha reservoir area is very low (10 kg/ha or below) Most of the reservoirs like Tandula (2275 ha.), Manohar sagar (2510 ha.), Murramsilli (1971 ha.), Gangrel (6935 ha.), and Hasdeo Bango (11700 ha.) are producing 10 kg ha or below. However reservoirs like Doodhawa (2510 ha.) have recorded average fish productivity of 58 kg/hectare, Khudia (1668 ha.) 55 kg and Sondure (1546 ha.) 34 kg/ha. Reservoir fishery was the main source of income of Mastsya Maha Sangh, Bhopal. Raipur Maha Sangh has potential for producing about 1000 t of fish annually from reservoirs under its juricidiction but it will require to work hard to achieve that, because they were the

main source of revenue.

Integrated fish farming

This can be helpful in increasing multiple use of resources for production and improvement in the income of fish farmers. There is great scope for duck cum fish culture and fish cum paddy culture in the new State. Duck cum fish culture has already made headway in the past in the erstwhile Sarguja, Raigarh and Bilaspur districts. Similarly paddy cum fish culture has potential in Durg, Rajnandgaon and Raipur districts.

In view of the past experience, these activities need to be expanded in a planned way. At least about 5% of the existing pond culture area of 0.49 lakh hectares could be brought under Integrated fish farming during next five years in the new state.

Culture of giant freshwater prawn *(Macrobrachium rosenbergii)*

Attempts made in the past in monoculture of prawn and prawn cum fish culture in Chhattishgarh area have been encouraging. Two constraints were however noticed which acted as damper.

a. High mortality of prawn seed (larvae/post larvae) during transit from suppliers in Andhra, Maharashtra and West Bengal. This resulted in very high landed cost of seed which ranged from Rs. 1500 to Rs. 2000 per 1000 larvae/post larvae.

b. High cost of prawn feed which ranged from Rs. 30 to 35/- per kg. by the time it reached the farmer.

For about five years trials were made for production of prawn seed at Khuttelabhata (Durg). Although breeding was successful there was always high mortality of larvae after fourth stage. Hence annual production of post-larvae could never go beyond 30,000 in any year. Past experience indicates that there is potential of prawn culture in the new State and fish farmers are also aware of this. If problems relating to transit mortality and high cost of feed are properly addressed, prawn culture can usher in a new era of prosperity on fish farmers of Chhattisgarh.

Culture of Magur *(Clarias batrachus)*

Magur is quite popular among the fish consumers of the State. It has scope for development in the new state but non availability of adequate Magur seed is the main constraint. Lately attempts have been made for the production of its seed. A small hatchery has been also established by Fisheries Department at Raipur. But so far there has not been any substantial production of magur seed. Hence this aspect shall be required to be addressed in the new State.

Prospects of Fisheries in Jharkhand State

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Jharkhand State has come into existence on 14-15 Nov 2000 as the 28th State of India. It has 2.20 crore population and 18 districts carved out of Bihar. The State has large tribal population fond of fish as food. They follow traditional method of culture. This being not effective, the production is very low.

Jharkhand has four major industrial towns i.e., Jamshedpur, Ranchi, Dhanbad and Bokaro and many smaller towns. The State has mining activities. A large number of outsiders who are economically sound live in the towns and can afford any price for fresh fish. Thus demand has opened up scope for importing fish from other States. Meeting the demand for fresh fish in the towns is the greatest challenge that Jharkhand now faces for which adequate water area, skilled farmers and quality fish seed are the foremost requirements.

Geography and Topography: Jharkhand State has many hilly rivers. Some of these are : Damodar, Swarnrekha, Koel, Karo and some parts of Ganga. Of all these, natural breeding grounds of major carp have been found only in Ganga river.

So, Carp seed of riverine origin always remains a problem in Jharkhand. Thus seed growers in nearby Jhalda and Purulia districts of West Bengal supply almost all seed requirements of Jharkhand, and also the parent Bihar State, in the same way as Andhra Pradesh supplies fish to north-eastern states. Jharkhand is bestowed with many large dams and reservoirs which have been constructed for various purposes like irrigation, hydro-electricity, supply of freshwater for domestic use etc. which can be utilized for producing large quantity of fish with proper management.

The land of Jharkhand is uneven. Only 25% of available water area has been made cultivable over a long period of time. Thus there are two types of lands found in the State. There are: the lower one which has more water retention capacity is called *done* and the higher one is called *tand* which is less suitable for cultivation. As such *done* land is the most suitable for construction of ponds for fish culture.

The land has less of organic carbon and calcium. It is more acidic. Therefore efforts to adopt corrective measures of soil is important before taking up aquaculture anywhere in the State.

Other Water Resources: Besides rivers and reservoirs, a large number of ponds of different ownerships (private, public and community) exist in the rural areas. Only 20-30% of them are under aquaculture based on traditional systems. The remaining are to be brought under fish culture. This apart, under various welfare schemes, ponds are being constructed for multi purpose use (irrigation, soil and moisture conservation) which does not cover aquaculture. There is great scope to undertake aquaculture too in these ponds.

Status of Fish Seed Availability in Jharkhand: Since there are not many fish breeding and seed collection grounds in Jharkhand the farmers are dependent on seed from hatcheries only (i.e., induced breeding). Over a period of past ten years, while hardly four or five hatcheries could be developed in erstwhile Bihar, they mushroomed in good numbers in neighboring West Bengal. Thus today the whole of Bihar and Jharkhand is destined to receive fish seed from Purulia, Jhalda, Naihatti and Howrah towns of West Bengal, where breeders and seed producers have developed in large numbers. Seed producers sell fish seed in millions to farmers in Jharkhand and Bihar. In fact, there are some companies in West Bengal which collect seed from private seed growers in that State, pack them in their own name and send to their agents in different towns of Bihar and Jharkhand connected to Calcutta by train.

In this situation the need is to identify natural breeding grounds in rivers and reservoirs of Jharkhand, to facilitate collection of spawn / fry / fingerlings. A simultaneous step to be taken is to increase the number of hatcheries, to a level of atleast one in each district.

Fish seed production in this newly formed State can be stepped up, not by merely increasing the number of hatcheries. There have to be a band of trained men capable of operating carp hatcheries, and raising the spawn produced at the hatcheries to a stockable size i.e., into fry / fingerlings. Once the needed number of hatcheries are established, seed farms set up, and the category of trained hatchery and seed production operatives are developed in the private setcor, there will be progressive relief from the present dependence for seed on West Bengal producers and the outflow of millions of rupees from the State to West Bengal will come down. The consequential self sufficiency infuses confidence among fish farmers.

Upgradation of culture system: This is another area in which honest and continuous effort is required for some years to come. The methodology of composite fish culture has not yet reached most of the farmers resulting in lack of knowl-

edge about the whole range of stages and steps in culture fishery management. Methods of pond preparation and other pre-stocking procedures, stocking formulae and precautions to be taken thereof, water and crop management etc., have not reached the bulk of the farmers. Hands-on training programmes are required to be taken up in this respect by the department, with help from the Central Institute of Freshwater Aquaculture, Bhubaneswar, or from Kolkata Centre of the Central Institute of Fisheries Education, Mumbai. The absence of trained professional cadre of fish farmers in the State is resulting in a low culture fish production. The present situation holds the danger of diverting them towards adoption of other agricultural activities and develop an erroneous impression on aquaculture as a non-profitable activity, a totally contrary perception that goes against the good name in the country on the prosperity blue revolution has showered on the stake holders

Extension methods such as exhibitions, film shows, kisan melas, posters, pamphlet etc. would have to be adopted for penetration of the virtues and profitability of fish culture to bring about an intimate awareness about aquaculture as a highly paying activity. The methods should be such that they would have a sharp and fast impact on the farmers & others concerned to participate in aquaculture work.

Technology back-up: Though FFDAs are working in all the districts of Jharkhand, barring the newly formed districts, the interaction of extension workers with the farmers from the point of view of fish culture is at a low ebb. In most of the districts, the farmers have no clear awareness that FFDAs also perform duties other than settlement of revenue ponds. This situation needs to be reviewed and in that light a well thought-out and well targeted approach has to be formulated to achieve focal impact on selected farmers in selected areas to start with, to increase fish production.

Marketing: The marketing of fish harvested from local ponds is highly unorganized. Seldom the wholesalers approach farmers with a bulk order. The most popular practice is to sell the product to those fishermen who harvest the fish on low wages. If the farmer approaches merchants in the wholesale market in the district headquarters, where fish imported from Andhra is mostly sold, he is offered very low price. This trend leaves no choice to the producer but to accept whatever is paid, as fish is a highly perishable commodity. There is no facility of receiving ice supplies in the villages. So much so, transportation of fish to markets is done without ice, thereby causing deterioration in quality. While insulated boxes and ice can be made available to fish vendors who procure fish at tank sites, the State Government can think of fixing a minimum price, with provision to buy if the market price goes below this level, through the district fishery administration / co-operatives / corporation.. This will help the farmers as this will ensure reasonable returns and provide impetus for improving production.

Research facility: The Government of Jharkhand has one research station at Ranchi which has the responsibility to cater to the research needs of all the 18 districts. The research set-up needs expansion, as it is impossible for this station to cater to the needs of the entire State. While the research station can concentrate on developing production packages for the benefit of farmers, the FFDAs should be equipped to extend the new technologies to the farmers, while taking care of other problems.

New Diversions: In order to bring about an increase in fish production through reduction in costs, integrated fish culture like poultry-cum-fish, duck-cum-fish, dairy-cum-fish, rice-cum-fish culture and prawn culture have to be promoted, in selected areas to start with. This step will not only keep the farmers engaged in managing the integrated activities in a such a manner that the frequency of generation of income will go up, thereby sustaining their interest in the activity. Other culture systems can be promoted as part of integrated farming. These can be snail culture, pearl culture, ornamental fish culture, trapa culture etc. Integrated farming system is catching up in various states of the country, particularly Punjab. Taking up of focal training programmes in this respect are crucial to establish the activity on sound lines.

Demonstration Farms: Now that the new State has come into being, state-level demonstration farms, museum, library and laboratory would have to established to demonstrate all the activities related to aquaculture to the farmers. This will have a significant motivating effect. The museum and library will cater to the research needs of the scientists, professors and students while the laboratory will help the farmers in getting the soil and water quality of their ponds analysed.

Central and World Bank Assistance: There are so many fisheries schemes which are financially assisted by the Central Government. These should be taken advantage of by Jharkhand state. Similarly projects can be submitted to World Bank for sanction in respect of reservoir fishery development, fish production in dug-out pits in colliery areas and pits of brick klins.

ICAR Institutes: Indian Council of Agricultural Research (ICAR) has many institutes for research and development in intand fisheries. These are: Central Institute of Fisheries Education (CIFE), Mumbai, Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar, and Central Inland Capture Fisheries and Research Institute (CICFRI), Barrackpore. These institutes also have their regional centres and conduct operational research projects in various States. Unfortunately, none of these institutes has any extension centre in Jharkhand. The State can be benefited by taking the help of these institutes for the betterment of farmers and for ensuring the upgradation of technological knowledge of fisheries officers of the State.

A focal and purposeful approach to take all the aspects forward as outlined above will augment fish supplies to the people of the State. More than this, the promotion of fish culture will provide jobs to a large number of unemployed youth of the State.

Fisheries Development in Manipur : Present Status and Future Plans

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Present Status

Fishery resources and fish production: Manipur State has fishery resources of the order of 56,460 ha. in the form of lakes, swamps, beels, reservoirs, streams, ponds, and low-lying water-logged areas. Of these, so far 16,000 ha., have been developed for fish culture. The State has produced 15,506 mt. of table fish and 115.10 millions of major carp seed during 1999-2000.

Fisher population: According to an estimate, there are 19,889 full time, 8,395 part time and 5,780 occassional fishermen operating in the different water bodies of the State.

Extension activities : The FFDAs of Manipur have brought under production 2,273.18 ha. of water area owned by 6,941 farmers. Of these, 3,934 fish farmers have been imparted training in intensive fish culture practices.

Under National Welfare Fund for Fishermen, a Centrally Sponsored Scheme, 300 housing units, 8 community tanks, and one Community hall have been constructed in addtion to the establishment of one Credit Co-operative Society. The construction works under the scheme, on another 82 housing units and four community tanks are also in progress.

So far 74 cases of death claims out of 2329 insured under the centrally sponsored Group Accident Insurance Scheme have been settled. Another 66 fishermen have also been enrolled under Group Insurance Scheme of the life Insurance Corporation of India.

Fishery Legislation in Manipur: The Manipur Fishery Act, 1988 and the Manipur Fishery Rules, 1998 are being enforced in Manipur. Under the provisions of the Act and the Rules, all the declared fisheries along with the lands within the defined areas vest in the Fisheries Department, Manipur. Consequent to the commencement of the Manipur Fishery Act, 1988, the Indian Fisheries Act 1897 (IV of 1897) and its application to the State, Section 13-A of the Manipur Land Revenue Act stands repealed. Since Section 13-A of Manipur Land Revenue Act has been repealed, the Manipur Fishery Act 1971 that empowers the Revenue Officers to control the Government Fishery has become null and void.

Future Plans

Keeping in view the projected population of about 34 lakhs in Manipur by 2000 A.D., the requirement of table fish is estimated at 37,400 mt. per annum based on the standard nutritional requirement of 11 kg as per capita consumption, as against the present level of fish production of 14,506 mt. For achieving the estimated requirement, it becomes inevitable to develop and monitor the culture activities properly in all the available fishery resourcces and to ensure effective exploitation. This is possible only through formulation of new plans/ programmes for overall development in the present fisheries scenario of the State. In this context, the following plans/ programmes are suggested.

1. Management and Action Plan for Development of Loktak Lake :About 50% of Loktak Lake, the biggest freshwater Lake in India, with a catchment area of 6845 sq. km and about 20,000 ha. in area is infested with floating mats of vegetation/*phoom* and submerged weeds, thereby causing considerable decrease in both flood absorption capacity and table fish production from the lake. In order to enhance fish yield of the lake, the following programmes are to be taken up : i) Removal of floating *phooms*, ii) Ranching of the lake with 1.2 crores of advanced fingerlings of major and medium carps, iii) Creation of ponds in the low lying areas by constructing bunds, and iv) Conservation of the lake into culture-based capture fisheries through proper legislation.

2. ***Fisheries Development of the Flood Plain Lakes*** : Flood plain lakes/ swampy beel areas/derelict waters comprising about 18,000 ha. constitute an important fishery and offers tremendous scope for development of both capture and culture fisheries. These areas which remain unexploited are to be developed to exploit upto the extent of their potential production of 12,000 mt. per annum.

3. *Conservation of some of the endangered indigenous species*: The declining trend of the commercially important indigenous species like *Tor tor, Tor putitora* (Ngara), *Labeo dero* (Khabak), *Labeo bata* (Ngaton), *Schizothorax richardsonii* (Sana-nga), *Wallago attu* (Shareng) etc., needs to be studied so as to evolve remedial measures for their conservation. Research work on the biotechnologies of hybridisation of locally important fishes with those of the major Asiatic carps and studies on the production of disease-resistant strains of fishes can be taken up in association with the Manipur University, Central Agriculture University and other Research Institutes.

4. *Establishment of Mini-Fish Farm (Jhora Farm) in Hill Districts*: The five hill districts of Manipur that cover about 9/10 th of the total area of the State have numerous rivers and streams and rivulets flowing through them. These water bodies have the potential to produce 25

mt of table fish annually if exploited properly. Keeping this in view, it is proposed to take up about 50 ha. of water area to be covered under fish culture by way of constructing Mini-Fish Farms (*Jhora* farms) and Integrated Fish Farming by constructing barricades, weirs, partitioned ponds etc.

5. ***Development of Riverine Fisheries*** : The State has ample scope for development of running water fisheries sourcing the system from the rivers Barak, Makru, Irang, Leimatak, Ijei, Jiri, Imphal, Thoubal, Iril rivers etc. Running water systems based on well-drawn designs have to be taken up to accelerate the fish production of the State.

6. ***Other important plan schemes*** : These are, i) Production of fresh water prawns; ii) Extension of cold chain system; iii) Establishment of Modern Fish Market; iv) Development of fish farming through educated unemployed youths under a project to be established; v) Establishment of Fishery Estate at Kha-Laisoi Fishery, Meichakpi Konjengsoi and Narangsoi Fishery in Imphal Wet District; and at Ungamlen.

Ocean Science Research Cell for AU

Andhra University has yet another prestigious centre in its kitty - Ocean Science and Technology Cell (OSTC) - sanctioned by the Department of Ocean Development of the Union Government.

The DOD envisages that the cell attached to the AU Department of Marine Living Resources would emerge as a centre of excellence in the near future by promoting pioneering and high quality frontier research in the area of coastal marine culture systems and developing human resource requirement for the sustained use of the vast resources.

Prof. K.V. Ramana Murthy, Head of the Department of Marine Living Resources and chairman of the Board of Studies and Research Coordinator of OSTC, said that a building for the purpose was constructed with the funds sanctioned by the DOD. The cell was equipped with reservoirs where seawater would be pumped into them through special pipelines laid for the purpose after passing through sand filtration bed and stored in the overhead tanks after further filtration. Then the pure seawater would be supplied to the laboratory where different research projects were under way for developing alternative species for aquaculture, he explained.

Prof. Murthy clarified that the cell would serve as a nodal centre for receiving proposals for research projects from university departments from all over the country. After scrutiny by a board of experts, they would be submitted to the DOD for funding. A scheme was also evolved to involve the aquaculture industry in developing proposals, related to problem- oriented research by contributing 25 per cent of the fund and DOD would provide 75 per cent share of funding for the proposal.

"The process was initiated in 1998 and a research agenda document was prepared after brain-storming sessions with experts in a national workshop for identifying various priority areas for research and other functions of OSTC," he said.

While development and management of broodstock of cultivable species (shrimp, fin fishes and molluscans), health management of coastal marine cultivable species, crop rotation with species of fin fishes, crop diversification with shell fish (bivalves species), development of the effluent treatment plant model for coastal aquaculture, hatchery seed production technology of cultivable species and culture of live-feed organisms, breeding of marine ornamental fishes, etc., were identified as priority areas for accepting research proposals. The centre had already received 40 proposals, he mentioned.

Of the forty proposals, four projects were already sanctioned to AU and Rs.73 lakhs had been sanctioned by the DOD. They are "Studies on broodstock (bank) development and management of tiger shrimp", "Disease management in coastal aquaculture systems with special reference to microbial diseases", "Pteria (winged pearl oysters) ecology, biology, seed production and sea ranching: and "Survey and mapping of oyster resources for production of pearls along north Andhra coast and south Orissa coast".

Prof. Murthy said the research in this field was essential to tap the vast marine resources in the country in a sustainable manner and also make the aquaculture industry and farming community overcome the crises by adopting scientifically tested techniques and procedures.

The cell organised a two-day workshop on 'Aquaculture diversification in India" on March 23 and 24 and a four-day training programmes on 'Health management in shrimp culture' from March 26 to 29 for personnel from aquaculture industry. Experts with field and laboratory experience in aquaculture technology interacted with the participants and offered guidance. While the workshop was inaugurated by Dr. C. Baburao, Chairman, Suvarna rekha Marines Ltd., the Training programme, participated by over 50 aquaculturists and several experts was inaugurated by Dr. K. Haribabu, MLA. Prof. Bright Singh from Cochin University, and Dr. Vijayan for the Central Institute of Brackishwater aquaculture participated in the Training Programme.

Inter-relations of the multitudinous factors influencing the socio-economic status of fisher communities at Hoshangabad

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Various reports documented earlier have provided valuable information on fisher communities all over India (Roy Chaudhury, 1969, Philipose, 1987; Pramanik, 1993; Gadhia *et al.*, 1999). However, no such efforts have been made to acquire knowledge on the fisher community dependent on Narmada river system located in Hoshangabad Dist of Madhya Pradesh, to find out the prevailing conditions and problems of the fisherfolk of the area. Therefore, in the present report an attempt has been made to evaluate and co-relate the socio-economic conditions of the communities and their fishing activities in the district of Hoshangabad, M.P.

In order to study the socio-economic status of fishermen community of the tahsheel Hoshangabad, five important landing stations like Vilpura, Sanechara, Madarbara, Sadarbazar, Kothibazar were selected. Before conducting the study, an acquaintence with the various social and cultural activities of the fishermen society of the area was made by staying in the villages for a number of days. Comprehensive door to door survey of fisher families was conducted by coming in contact with their day to day life, their social and cultural activities and different festivals they celebrate. Personal interviews with the fishermen were conducted to gather information on the above aspects with the help of a pre-fixed questionnaire on 320 families in the period November 1998 to March 1999. Indirect informations were also obtained from different educational institutions, co-operatives, fisheries offices of the state government, research centres of C.I.F.T., C.I.F.E., C.I.C.F.R.I. etc.

The data thus obtained were analysed on the basis of urban and rural populations, caste, sex, age etc. The fishing activity was also divided on the basis of full time and part time workers, marketing systems, craft and gear possessions and traditional processing systems, etc.

Results and Discussion

The data collected are divided into two categories namely, socio-economic activities (Tables I and II) and fishing activities (Table -III).

Table I. Showing the difference in engagement of urban and rural people in fishing activities

Urban/Rural families	*Caste wise (%)*	*Male(%)*	*Female(%)*	*Boys(%)*	*Girls(%)*
Urban 135	SC-4.3 ST-7.6 GEN-88.1	39.2	32.7	16.1	12
Rural 185	SC-10.8 ST-26.9 GEN-62.3	34.9	21.3	26.6	17.2

The survey on the five villages revealed that the fishermen live in remote fishing villages isolated from the mainstream. They are basically poor and socially neglected. Compared with urban and rural classes, it was found that 39.2 and 34.9 percent males, 32.7 and 21.3 percent females respectively were engaged in fishing activities. It is important to note that a good number of women were found to engage themselves directly in the fishing activities as well as fish trading mostly with their male partners. Comparatively, in rural areas the percentage of boys and girls engaged in the profession are found to be more. On the basis of caste, the fisher community is mostly bracketed with general caste structure and involvement of SC and ST people in the profession is comparatively meagre (Table I). Thus majority of fisher community are also deprived of facilities enjoyed by SC and ST categories of people. This assessment is in agreement with the reports of Unny (1996).

When the distribution of the fishermen on the basis of monthly income through fishing is considered, surprisingly, it is observed that in all the five villages most of the families are economically backward and fall under the Rs.500 to Rs.1,500/- monthly income group (Table II). With this poor economic stature no fisher family can thrive well and be at par with the other classes of the society. So much so, they are becoming increasingly poverty stricken and fishing is fast becoming a secondary-cum-tertiary occupation for fisher folk (Patrikar, 1993 and Gadhia *et al.*, 1999).

Table II. Showing the distribution of fishermen on the basis of monthly income through fishing

Landing Centres	*Total no. Fisher Families*	*Upto Rs.500 (%)*	*Rs.501 to Rs.1000(%)*	*Rs.1001 to Rs. 1500 (%)*	*Rs.1501 to RS.2000(%)*	*Rs.2001 and above(%)*
Vilpura	215 (8.37)	18 (19.53)	42 (54.88)	118 (12.56)	27 (4.65)	10
Sanichara	37 (10.81)	4 (29.73)	11 (45.95)	17 (8.11)	3 (5.45)	2
Sadarbazar	28 (46.43)	13 (32.14)	9 (14.29)	4 (7.14)	2	-
Kothibazar	26 (26.92)	7 (53.85)	14 (19.23)	5	-	-
Madarbara	14 (42.86)	6 (50.00)	7 (7.14)	1	-	-
Total	**320 (15.00)**	**48 (25.94)**	**83 (45.31)**	**145 (10.00)**	**32 (3.75)**	**12**

In Hoshangabad fishing as a full time occupation is noticed only among 18.44% of fisher families. Remaining 81.56% families have adopted it as a part time occupation (Table III). Most of the new generation fisher families are least interested to engage themselves in fishing activities. They prefer to work as a daily labourer in agriculture, factories, business centres, hotels and offices.

So far as crafts and gears are concerned, it is found that they are all of small size, locally made, square shaped boats either of their own (25-45%) or hired ones. They are manually operated.

Most of the families have their own gears (61-100%), mostly gill nets, cast nets, disco nets, pilna, hook and line (Sasmal & Qureshi, 1996b). For marketing of the catches, 35-78% of the fisherfolk prefer self-marketing due to drastic decline in the catches of Narmada river fishery (Unni, 1996; Sasmal & Qureshi 1999a). In this aspect, the females take part actively and prefer to sell for cash in the nearby township (50.94%).

One important feature to mention here is that a few aged fishermen in all villages still process fishes following their traditional local methods (8.75%). They smoke the fishes for better taste and odour with grass and wood smoke to secure higher prices for the less important fishes.

The study has shown that no modern fishing system has been developed in the district. The attempt of the co-operative societies to improve the condition of the Narmada river fishery and the economy of the fishermen have also not proved to be successful. Most of the societies have stopped functioning only due to the reason of decline in catches in Narmada river system. To meet the demand of increasing population, heavy destruction of fry, fingerlings, juveniles of various fishes is taking place. This causes drastic reduction of fish population of Narmada river (Philipose, 1987). Therefore, for the survival of the fisher community dependent on the Narmada river system, special attention towards the conservation of fishery by the government is very much needed.

Acknowledgement

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Table III. Showing the fishing activities of the five landing centres at Hoshangabad

Landing Centres	*No. of fishermen families*	*Full time (%)*	*Part time (%)*	*Own Craft (%)*	*Own gear (%)*	*Self marketing (%)*	*Processing (Smoked) (%)*
Vilpura	215	38(17.67)	177(82.33)	78(36.28)	215(100.00)	98(45.58)	14(6.51)
Sanichara	37	9(24.32)	28(75.68)	11(29.73)	37(100.00)	13(35.14)	3(8.19)
Sadarbazar	28	6(21.43)	22(78.57)	7(25.00)	18(64.28)	22(78.57)	2(7.14)
Kothibazar	26	3(11.54)	23(88.46)	10(38.46)	16(61.53)	19(73.08)	6(23.08)
Madarbara	14	3(21.43)	11(78.57)	6(42.88)	14(100.00)	11(78.57)	3(21.43)
Total	320	59(18.44)	261(81.56)	112(35.00)	300(93.75)	163(50.94)	28(8.75)

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Closed Season on the East Coast

Various Fisheries Associations of A.P, supported by the Association of Indian Fishery Industries, have been observing closed fishing season off A.P. coast voluntarily from 16th April which will last upto May end. The same tradition is continued for this year too. This voluntary declaration has now acquired sanctity with the Government of A.P. also officially declaring closed fishing season during the same period.

Responding to the appeals from various associations in A.P., in the coastal districts of A.P. have also declared closed seasons more or less during the same period. These nitiatives have now received have now received a shot in the arm with the Govt. of India issuing an order imposing a ban on operation of all deep sea fishing vessels in the EEZ off the various East Coast States have been issued by the Govt. of India in the Ministry of Agriculture. These orders will be valid upto 31st May, 2001.

The issue of orders by the Govt. of India as mentioned above is in response to the various appeals from the Association of Fishery Industries and the other fishery associations and it is for the frist time that such a ban in the EEZ of East Coast has been promulgated

MPEDA Introduces Registration Scheme for Shrimp Hatcheries

Shrimp hatcheries in the country would soon come under a code of practices formulated by the Marine Products Export Development Authority (MPEDA). It is envisaged that this code would be the main feature of the shrimp hatchery registration scheme for ensuring supply of healthy seeds to the shrimp farmers.

The scheme of registration of shrimp hatcheries introduced by MPEDA is directed at prevention of disease outbreaks among cultured shrimps. Owing to disease incidence it is stated that a loss of the order of 15,000 t of shrimps is taking place, leading to an indirect loss of around Rs. 350 crores since 1995.

Vertical transmission of diseases from mother prawns to larvae during hatchery production of seeds and unhealthy practices have been cited as two of the major causes of large scale outbreak of diseases in shrimp aquaculture.

Underscoring the significance of the code of practices, Mr. M. Sudarsan Swamy, President of Andhra Pradesh Shrimp Hatcheries Association is reported to have said recently that "The scheme is very important in the long-term interest of the industry. We have had extensive discussions with MPEDA on this proposed scheme, which is to be adopted on a voluntary basis. Our industry has grasped significance of the quality parameter in seed production and responded well to the scheme."

He pointed out that the major operators among the 200- odd hatcheries in the State were poised to register themselves by March-end for which applications were being circulated. "Gradually, we expect all the hatchery operators to fall in line with the registration scheme," Mr. Swamy added.

Once the registration scheme comes into effect, financial assistance from MPEDA would be given to such of the hatcheries which had obtained and are holding valid certificate of registration, it is learnt.

On registration, MPEDA is expected to assess the facilities at the hatcheries, and the degree of present level of complying with the code of practices and status of quality of seeds. A provision is made for cancellation of permanant registration on contravention of the conditions in the certificate of registration and recovery of financial assistance extended.

MPEDA is poised to set up healthy shrimp broodstock at Andaman and Nicobar islands for supply to shrimp hatcheries on the mainland.

10th Five Year Plan: Fisheries
Working group constituted

Planning Commission constuited in Nov 2000 a Working group on Fisheries for 10th Five Year Plan, with Dr. K. Gopakumar, Dy. Director General (Fisheries) as the Chairman.

There are 14 members in the Working Group, besides the chairman. The Members are : 1) Ms Nita Choudhary, Joint Secretary (Fisheries); 2) Dr. M. Sinha, Director CICFRI, Barrackpore; 3) Dr. S. Ayyappan, Director, CIFE; 4) Dr. V.S. Somvanshi, Director General, Fishery Survey of India; 5) Mr. Jose Cyria C, Chairman MPEDA; 6) Mr. M.K.R. Nair, Fisheries Devt. Commissioner; 7) Dr. S.N. Dwivedi, Ex-Addl. Secretary DOD; 8) Dr. P.V. Dehadrai, Ex-Dy. Director General (Fisheries); 9) Dr. Y.S. Yadava, Co-ordinator, BOBP and a few others. Dr. D.P.S. Chauhan, Dy. Adviser (Fisheries), Planning Commission is the member secretary.

The terms of reference of the working group are very eloborate covering all aspects of fisheries development with perticular emphasis on formulation of programmes as an 'Aquaculture Development Plan' to double the productivity and also on formulation of programmes for development of fisheries in open waters (reservoirs, rivers, lakes etc.,) saline waters, use of water-logged areas and cold water fisheries in hill areas. Development of post harvest technology and linking production and processing to enhance exports has also been emphasized. The Group has been asked to submit the final report by the end of May 2001.

Growth of Indian Fishing: Garware's Unique Role

All capture and culture fishery development efforts culminate in efficient harvesting of the crop; Garware Wall Ropes enters into the picture in the final phase. The fishing enterprises, the bulk of them, use nets fabricated out of quality filament, twine or webbing supplied by Garware Wall Ropes. These supplies have fecilitate a phenomenal upsurge in Indian fish production. Apart from this vital contribution to national fish production, Garware Wall Ropes exports half of its production.

Twine Twisting Section

Garware Filament Co. Ltd was set up in 1969 in Pune. Later, incorporated in 1976 as Garware Wall Ropes Ltd, it became fully operational and soon emerged triumphantly as the Indian market leader in synthetic fishing net twine and ropes and a major exporter of the products. In 1994 the company diversified into the production of fishing net webbing initially at Pune, but later shifted the production venue to its modern plant of International standards set up at Wai, a pollution free and an environmentally inviting place. Wai is around four hours away by road from Pune.

The plant set up at Wai has two production units and a third one is coming up.

In 1970-71, the total Indian fish production was around 0.75 mill t. The location of new grounds and increase in fishing effort, predominently through nets made out of filament, twine and webbing supplied by Garware Wall Ropes has catapulted the production to 5.3 million t by 1999-2000.

As a measure to meet the growing demand for the webbing and also net making material of its manufacture, Garware established divisional offices in Mumbai, Chennai, Kolkata and Delhi. The company also has sales offices in Bangalore, Kochi, Cuttack and Visakhapatnam. Sales Depots have been set up at several places for the convenience of fishermen. Besides Bangalore, Mumbai, Kolkata, Chennai and Visakhapatnam, there are depots set up by the company at 15 centres in the country (at Contai, Daman, Gandhigam, Kutch, Goa, Mahe, Palgarh, Satpati, Ratnagiri, Pondicherry, Surat, Tuticorin, Udupi, Yanam and Veraval) to facilitate supplies of filament, twine and webbing to fishermen at their door step. This network has facilitated and contributed in a large measure for the spectacular increase in fish production of the country.

The company also has two offices in USA (One in North Carolina and one in Seattle), and one in Dubai for promotion of exports of its products.

There has been a symbiotic relationship. Garware harnessed the patronage that flowed from fishing stakeholders and net making enterprises leading to increased supply of synthetic filament, twine and webbing to them. The result of this has been higher fish landings which have bestowed a measure of prosperity among fishermen. Fishermen of Gujarat, Tamilnadu and Kerala are Garware's frontline patrons, closely followed by the super second line fisher patrons from Maharashtra, A.P., Orissa, West Bengal and Karnataka. No wonder that with its superb reputation of quality, Garware earned the cherishable trust of Indian fishermen, a set of professionals who do not get convinced easily.

Quality Control Room

Delivery Section

Mr. R. N. Telang
Director, Technical Services

The strength of the company, as is evident, stems from a non-conpromising adherence to quality and timely schedule of supplies, whether in relation to exports or domestic marketing.

Garware has a strong presence at Visakhapatnam, the hub of industrial fishing activity. One of the major exporting centres of marine products of the country, the place shot into prominance because of the strong shrimp, cephalopod and fish harvesting capability it has acquired (imparted mostly by Garware nets) to cater to the needs of processors and exporters. The Branch of the company in Visakhapatnam, as else where, specialises in timely supplies. In fact, the prosperity of the fishing community is entwined with the corporate culture of the company. Garware plays the crucial role of keeping the industrial fishing activities from Visakhapatnam fishing harbour vibrant.

Half of Garware products are exported to several countries. It is good to know that Garware's plant at Wai is the second largest in the world.

Indian Fishing industry is the main outlet of domestic supplies of the company. Looking beyond fishing sector, what one learns is that whoever needs ropes and nettings, be it Navy, Army, Shipping, Fisheries Departments and so on the bulk of the market share goes to Garware.

The company has international dimensions. In fact, it has emerged as an Indian-based multinational in the field of ropes and fishing net making material. Having inculcated a high order of efficiency and competence among its managers and other functionaries, Garware is now poised to switch over to a 100% export-oriented set up. With upgradation of production lines top most on its mind, the company is now working in this direction, with the involvement of six foreign specialists at its Wai plant.

The dynamic leadership imparted by Mr. Vayu Garware, the Director incharge of overall operations and the management of the company, virtually keep the production and marketing activities of the company in top gear and vibrant.

There are talented professionals, who take care of the technical services and various linkages. One of these is Mr. R.N. Telang, Director, Technical Services and Mr. R.R. Sardesai, Director incharge of various other matters.

The company has an inimitable system of strengthening its relations with fishermen. The management holds the view that fishermen should know how the filament or twine or webbing they get is manufactured. Fishermen from various parts of the coastline are encouraged to visit the factory at Wai. The visiting groups are well taken care of and the manufacturing processes are explained to them. The company conducts tournments too for fishermen.

The well co-ordinated and integrated efforts of a well-knit team enables the company to keep the fishing industry supplied with nets without any let or hindragee. One would shudder to imagine what would have been the fate of the industry, if Garware had not been keeping the stake holders supplied with material to make their nets. The nation exports over Rs. 6000 crores worth of marine products annually. A good share of the credit for this achievement goes to Garware, for, the primary means of catching fishes, shrimps, prawns etc., for domestic consumption as well as exports are fishing nets and most of the fishermen have them because of Garware Wall Ropes.

D.S. Murthy Inagurated PCR lab at SIFT, Kakinada

Mr. D.S. Murthy, Commissioner of Fisheries, Andhra Pradesh has inaugurated a PCR laboratory set up at the State Institute of Fisheries Technology, Kakinada on 17 March 2001. Largely attended by farmers and various fisheries workers. this facility has been acclaimed as a boon to shrimp hatchery owners and shrimp farmers.

This is the first PCR laboratory set up by A.P. Fisheries Department. In addition to helping the farmers in the diagnosis of of white spot virus, the lab will also take up tests regarding stress on seed and ectocommensals and necrosis in larvae by observing the seed under Charge Couple Device attached to the microscope. Water quality parameters would also be tested based on samples given.

It is stated that fees for PCR test is Rs. 1000/-

FISHING CHIMES

SHRIMP 2001

September 27-29 Chennai, India

SHRIMP 2001, the fourth World Conference on the Shrimp Industry and Trade, organised by INFOFISH in association with the Marine Products Export Development Authority (MPEDA), FAO-GLOBEFISH and the Sea Food Exporters' Association of India (SEAI), is scheduled to be held at Le Meridien Hotel in Chennai from 27 - 29 September 2001. William Chauvin, President, Shrimp World Incorporated and publisher of Shrimp Notes, the widely read newsletter on the shrimp market, will be the Chairman of the Conference.

The highlights of the conference include global resources and supply situation, major markets and market trends, products, value addition, quality assurance, aquaculture and technological developments, conservation, environmental and trade issues, investment opportunities etc. SHRIMP 2001 will be a better occasion for all those involved in the shrimp business to meet and discuss various aspects of the shrimp industry. More details can be obtained from INFOFISH, PO Box 10899, 50728, Kuala Lumpur, Malaysia Tel: + 603 2691 4466, Fax: + 603 2691 6804 E-mail : infish@po.jaring.my or infish@tm.net.my or visit the web site: http://www.infofish.org

Red Chamber may shift base to India

The curtain was rung down on the 13th India International Seafood Show here on 11th Feb 2001, with all the participants describing it as the biggest success ever.

Mr. K. Jose Cyriac, Chairman, MPEDA and Mr. Elias Sait, President of SEAI, said the show had attracted 586 Indian delegates and 88 importers, besides 568 aqua farmers, who happened to be the official participants at the show for the first time.

The show, which besides 142 stalls showcasing Indian marine products and the country's advances in exports, supplies of processing machinery, ancillary equipment, acquaculture farm accessories, feed and shrimp farm technologies, had experts who spoke on aquaculture, fishing sector, banking and insurance and value addition.

The show, which had the Association Indian Fishery Industry (AIFI) as one of the organisers, not only had the participation of shrimp farmers and shrimp hatchery operators for the first time, but also served to realise the objective of prioritising aquaculture as an important growth sector both for boosting exports and fostering socio-economic development in rural areas. It underscored the need for hastening the passage of the pending Aquaculture Authority Bill in Parliament.

The show brought into focus for the benefit of importers, the potential that Andhra Pradesh held for aquaculture sector growth.

Mr. Cyriac pointed out, that the show not only facilitated an interaction between exporters and importers but resulted in a major U.S company, Red Chamber, the biggest importer of Indian sea food, evincing interest in shifting its reprocessing base from China to India. Delegations from Japan, the U.S. and European Union gained first-hand knowledge of the potential of Indian aquaculture and the deepsea fishing sectors. The Japanese delegates showed interest in tapping tuna resources in Indian seas, he added.

The $ 1.30 - billion direct investment proposal of Red Chamber is not only in in respect of value addition, which the Indian seafood industry is keen on shoring up but reflects a shift in the investor's priorities from China to India.

Both the MPEDA and SEAI described Red Chamber's proposal as one of the major outcomes of the Seafood Show. Red Chamber was honoured with the Friend of India award during the show for being the largest buyer of Indian marine products from the U.S.

Mr. Ming Bin Kou, Chief Executive of Red Chamber, said the show had 'turned out to be a much larger event than I had expected' and observed that the proposal for direct investment in India for marine products procurement, processing and value-addition would mean a shift in a major part of his company's operations undertaken in China.

He said shifting priorities from China to India made business sense, for, instead of transporting the raw material sourced here to China for processing, the operations could be undertaken locally.

Responding to the development, Mr. Cyriac said 'Red Chamber is transporting much of the raw material sourced in India to China and the company's plan to reprocess shrimp here is a good sign of our efforts at boosting value-addition in our marine products exports. With value addition, the quantity of exports may go down, but the price realisation would be higher and this is what we seek'.

There are indications that the initial investment by Red Chamber may come to Andhra Pradesh.

Shrimp farmers, according to Mr. M. Sudarsan Swamy, President of Andhra Pradesh Shrimp Hatcheries Association, were for the first time exposed to 'what products their produce finally turns into'.

Mr. Ranjit Bhattacharya, MPEDA Vice-Chairman, and Dr. K. Hari Babu, president of AIFI, participated.

COASTAL AQUACULTURE : ISSUES OF ECONOMICS, EQUITY AND SUSTAINABILITY

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Coastal aquaculture basically requires availability of brackishwater and seed of the selected brackishwater species for the purpose of stocking. One of the most ideal environments for development of brackishwater aquaculture some years back was the Kandaleru creek area in Nellore district of Andhra Pradesh. With the aquaculture sector getting encouragement from the Government of India and also the Government of Andhra Pradesh, entrepreneurial skills and business acumen were emerging predominantly in the development of aquaculture in Nellore district at one stage. Shrimp culture had its origin in this district in the year 1978 at Duggarajapatnam in a water area with an extent of two hectares. Between 1989 and 1994 an extent of 4365 ha. were brought under shrimp culture in the district. The species farmed were *Penaeus monodon* and *Penaeus indicus*. The rate of return on shrimp farming was at an unimaginable 600 percent. In addition to the growth in production and area there was also simultaneous development of ancillary and allied industries like hatcheries, feed manufacturing companies, processing companies, ice plants and also disease diagnostics laboratories.

This paper is intended to highlight 1) The growth in area and production under aquaculture; 2) Growth and development of ancillary and allied industries and, 3) The trends in changes in culture patterns and composition, sustainability of enterprises *vis-a-vis* economics and equity.

Growth in Area and Production

Table 1 gives the area and production of culture shrimp in India and in Andhra Pradesh. Area under shrimp farming increased from 70,700 ha in 1992-93 to 1,41,591 ha in 1997-98 and shrimp production increased from 47,000 tonnes in 1992-93 to 66,868 tonnes all along the Indian coastline. During the same period of time area under shrimp culture increased from 19,500 ha in 1992-93 to 66,290 ha in 1997-98 and production from 26,000 tonnes to 34,075 tonnes in Andhra Pradesh.

Table 1 : Area and Production of culture Shrimp.

	1992-93	*1993-94*	*1994-95*	*1995-96*	*1996-97*	*1997-98*
Andhra :A	19500	19500	34500	50000	60249	66290
Pradesh :P	26000	26000	34000	27140	30577	34075
India :A	70700	82540	100700	118983	135582	141591
:P	47000	62000	82850	70573	70686	66868

A=Area in ha. P=Production in tonnes

It can be seen from the Table 1 that rate of increase in area under shrimp farming in Andhra Pradesh has increased at a faster rate than the rate at which area has grown at the All India level. Area has increased by 42 percent on an All India basis while it has increased by 240 percent in Andhra Pradesh.

As far as production trends are concerned, it has increased by 42 percent on an All India basis and by 31 percent in Andhra Pradesh.

The Table also reflects the fact that yields were appreciably higher during the initial years and had declined during the later years. Production and productivity have been declining over the years especially after 1994, primarily because of management problems. At All India level the rate of increase in area was about 22 percent from 1993-94 to 1994-95 while it had declined to around 4 percent from 1996-97 to 1997-98 (Krishnan *et al.* 1999). As far as Andhra Pradesh is concerned the rate of increase in area was to the tune of 77 percent and 1 percent respectively for the same period of time. Therefore it can be concluded that area changes under shrimp farming in Andhra Pradesh is duly reflected in the All India figures.

The Development of Ancillary Industries

One of the major theories of economics of development relates to unbalanced growth strategy. This comes about as the result of either forward or backward linkages. By forward linkages prior establishment of infrastructure is meant with a view to developing a particular preidentified sector. By backward linkages we mean establishment of infrastructure and development of ancillary industries as a result of a particular growth sector getting established in a particular area or region. Aquaculture development has resulted in the generation of backward linkages wherein infrastructural facilities like electricity, roads, drinking water, development of ancillary industries etc. have come into being.

Table 2 gives an indication of the growth of ancillary industries in Nellore district as a result of development of brackishwater aquaculture. Prior to 1992, farmers purchased shrimp seed collected from the wild and also prepared their own shrimp feed. With expansion of aquaculture in the area, the demand for seed went up and as result of this, a number of hatcheries were established in Nellore

Table 2 : Growth of ancillary industries in Nellore district

Ancillary industries	*1990-91*	*1992-92*	*1994-95*	*1996-97*	*Total Capacity annual*
Hatcheries	0	4	30	33	2380 million pieces
Processing Plants	0	3	6	8	24000 Mt.
Feed mills	0	13	14	14	78000 Mt.
Ice plants	8	14	22	24	285 Mt.

Source B.F.D.A Nellore

district. There were 4 hatcheries in 1992-93 and the number went upto 33 in 1996-97 producing 2380 million PL. Similarly, there were no feed mills in the year 1991. 14 feed mills had been established in the district by 1996-97, producing 78,000 mt of pelleted feed in the district. During the same period of time the number of processing plants in the district increased from 0 to 8, producing, 24,000 mt of precessed seafood and the number of ice plants increased from 8 to 24 producing 285 mt of ice day. All this happened during post - 1992 scenario. The corporate sector farms set up hatcheries and feed mills. Farms greater than two hectares in size used hatchery seed and purchased feed from local industries. All the hatcheries incidentally had 1650 workers, the 14 feed mills employed 840 workers and 16 ice plants had about 400 workers.

Growth with sustainability, Economics and Equity

Aquaculture has of late generated lot of criticism. It has been accused of enthusing farmers to shift their interest from regular land crop enterprises to aquaculture. They have also been accused of environmental degradation and causing drinking water salinisation, among various other charges.

Any sector identified for growth must necesssarily be accompanied by not only monetary benefits in the short run like subsidy and loans, tax holidays and a host of other benefits but also by proper legislative support wherein issues of sustainability and equity are taken care of from the initial stages of the growth of the sector.

Various systems of farming like traditional, extensive, improved extensive, semi-intensive and intensive farming have their own advantages and disadvantages. Each one of them when viewed in juxtaposition with the species farmed and the area in which the farming takes place will have their own implications with respect to sustainability, economics and equity.

Table 3 gives an indication of the three norms of sustainability, economics and equity viewed in conjunction with the species farmed and the intensity of farming.

It can be seen that there is always a compromise in terms of economics and sustainability. Any system of farming that farms saline species tends to be less sustainable but more lucrative. Again, species that require less saline environments for their growth tend to be less remunerative. This is particularly true in the western world where the demand for tropical marine water species is more. Equity is an issue that is to be considered more in terms of the requirements of alleviating poverty and restoring economic equality among the different sections of the populations. Therefore, since it has socialist leanings, it is a requirement of the government that has set the priorities and thus must be considered in isolation of other objectives.

Thus the basic issue is one of derived demand i.e., demand backed by capacity and willingness to pay. It is therefore imperative that a dramatic change in the tastes of the end consumers has to be diverted towards more sustainable species. Thus, the entire issue is one led by market demand. It is a question of who will tackle this issue and at what fora. The Seattle round of talks of the WTO had discussed at length, issues pertaining to labour component in manufactured products but did not discuss issues of sustainability in agriculture including aquaculture. These issues need to be addressed at the grass root level at least among the countries involved in exports and imports of sea food to arrive at some conclusive recommendations.

Table 3 : Matrix of species, Systems and Issues in Aquaculture

	Extensive			*Imp. Extensive*			*Semi-Intensive*			*Intensive*		
	Sus	*Eco*	*Equ*	*Sus.*	*Eco.*	*Equ*	*Sus.*	*Eco.*	*Equ*	*Sus.*	*Eco.*	*Equ.*
Saline water Sp.	Y	N	Y	Y	Y	Y	N	Y	N	N	Y	N
Low salinity Sp.	Y	N	Y	Y	Y/N	Y	Y	Y	N	N	Y	N
Freshwater Sp.	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y	N

Sus.=Sustainability Eco.=Economics Equ.=Equity Y=Yes N=No

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Andhra Pradesh Newsletter

From **K. Simhachalam**

Healthy Hatchery Shrimp Seed Supply to Farmers : Legislation mooted

It is reported that the Government of Andhra Pradesh intends to promulgate a legislation that would make it compulsory for the shrimp hatcheries to supply disease-free shrimp seed to the farmers. This was announced by the minister for fisheries, A.P., Mr. N. Narasimha Rao in the A.P legislation assembly. He is also reported to have said that the fisheries department would set up disease diagnostic laboratories, to monitor the health status and sustainability of shrimp culture at farms along the coastline, at selected centres such as Kakinada, Visakhapatnam and Nellore. It was also mentioned by the minister, according to the report, that government would take all needed steps to prevent capture of wild shrimp seed.

As a follow up action to the policy of the government to encourage shrimp farmers to organise themselves into groups for pursuing common and conducive culture systems so as to ensure healthy crops, it was mentioned by the minister that 94 aqua clubs had already been set up. During the discussions, legislators were stated to have urged upon the government to take needed steps to provide loan facilities and subsidies on power tariff to aqua farmers.

Pollution in Kolleru Lake

According to a study conducted by Mr. A. Srinivasa Rao in connection with his doctoral thesis, it is stated that several inimical aspects in respect of Kolleru lake have come to light. The lake, which was a predominently freshwater one, has now turned saline at several points and the fish of the lake is stated to have been contaminated with pesticides, polycyclic aromatic hydrocarbons and heavy metals. The study also revealed that the maximum concentration in the lake is 246 nanograms per litre for alfa-benzene hexachloride, 298 ng per litre for lindane, 699 ng per litre for malathion and 225 ng litre for endosulfan. It is also stated that the polycyclic aromatic hydrocarbons level is 0.425 microgram per litre for anthracene, 2.015 mgl for fluoranthene, 0.2 mgl for pyrene and 0.599 mgl for crysene..

Shrimp Farmers Seminar

Bhimavaram, AP : 26/Feb/2001

A seminar of shrimp farmers was held at Bhimavaram in A.P. under the auspices of the AP Shrimp Farmers Action Committee. Large no. of shrimp farmers participated in the seminar. Various speakers pointed out that, for want of an integrated and comprehensive policy for the development and monitoring of shrimp culture in the state, farmers had been incurring heavy losses mostly because of disease incidence. The seminar called upon the government to set up a suitable machinary for the supply of quality shrimp seed and for eradicating the harmful role being the played by middlemen to the utter disadvantage of shrimp farmers and for providing the needed encouragement to the farmers for excavating new shrimp farms and to develop the activity in a harmonious manner so as to ensure reasonable profits. It was observed by several of the participating farmers that in case government failed to respond to their requests, the farmers would be forced to launch an agitation for the realisation of their demands.

The seminar expressed itself totally against the move on the part of the central government to levy 2% cess on aqua exports. It was pointed out that although the cess would be levied on the exporters, the burden would actually fall on the farmers.

It was also appealed that the state government may monitor the price trends of seed and feed and also the quality of these supplies. As there was no monitoring system at present, the farmers were incurring heavy losses, it was mentioned. It was also demanded that the drainage system also should be properly renovated and reformed so as to ensure that effluents do not cause any harm to the production. The seminar also demanded the withdrawal of its present practice of levying of Rs. 500 per acre for taking in salt water from creeks etc., for culture. It was appealed that this levy may be in tune with the same rates as collected from other land-based farmers.

Another demand voiced by the participants was that special insurance schemes should be formulated to safeguard the interest of the farmers in respect of culture shrimp crops. There was also a demand for the provision of the needed cold storage facilities. Pointing out that government itself had been encouraging land farmers to adopt alternative crop production methods for the reason that paddy cultivation was not profitable, the farmers at the seminar demanded that the paddy cultivators should be allowed to excavate ponds for aquaculture as a measure of diversification and to enable them to come out of their adverse financial predicament. It was also mentioned that the farmers were now restructuring themselves by taking up the culture of giant freshwater prawn in paddy fields by deepening them as needed. As they were being prevented from excavating their fields for taking in larger quantitites of water required for culture, government should take urgent steps to prevent harassment to which they were now being subjected to.

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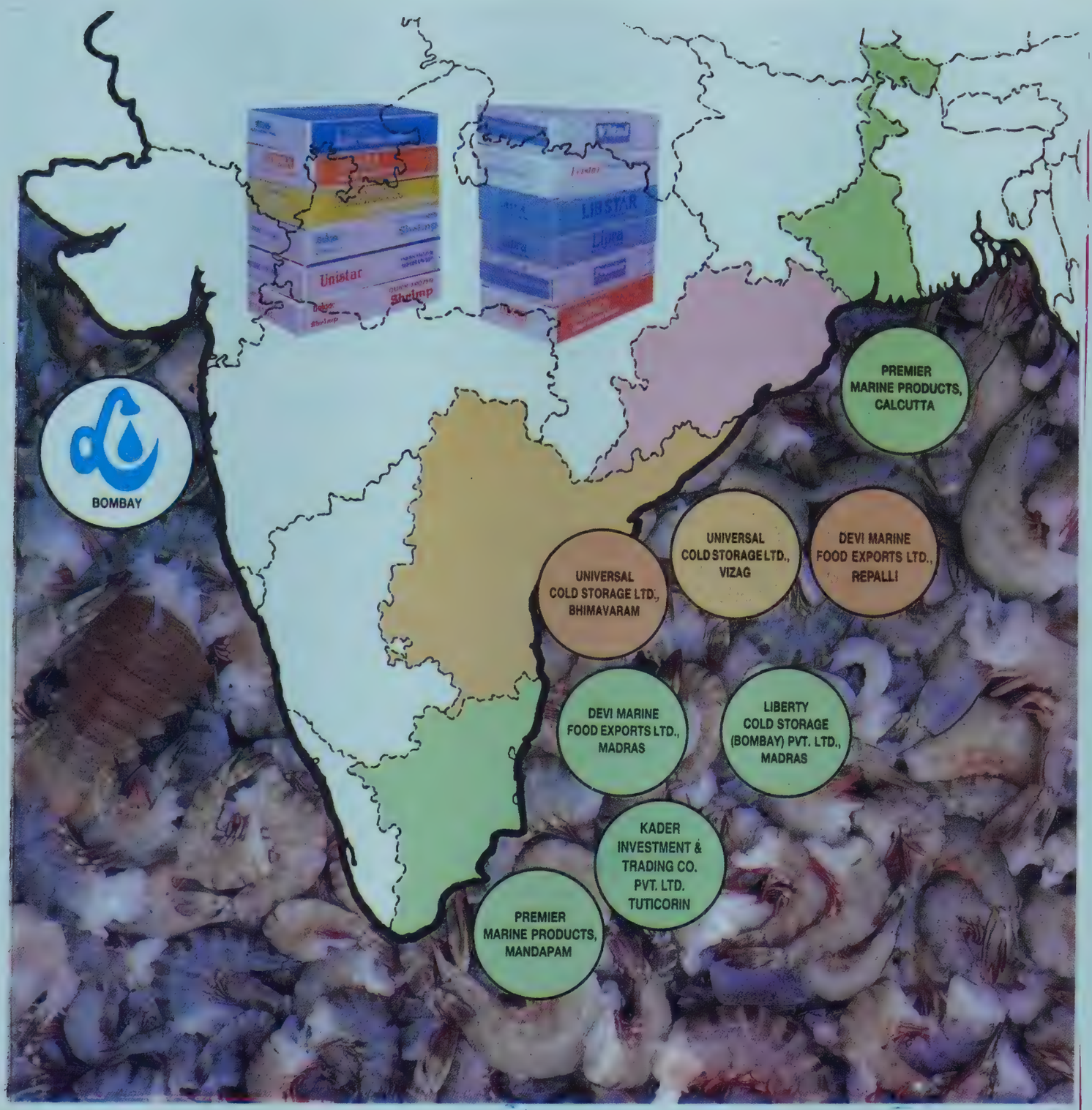

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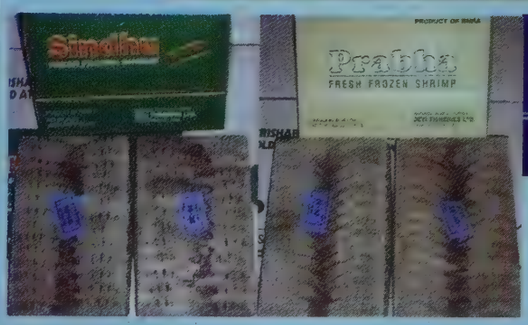

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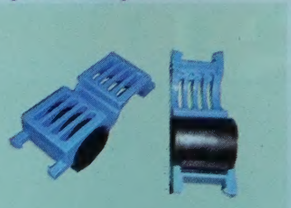

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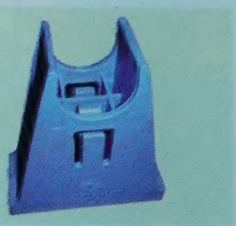

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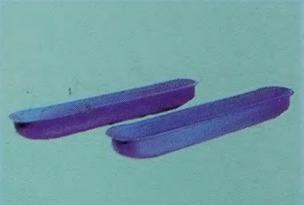

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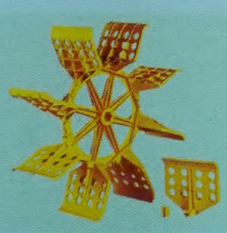

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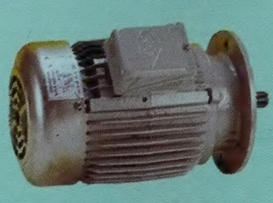
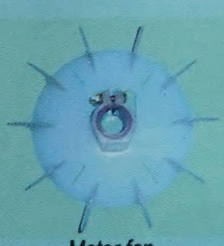
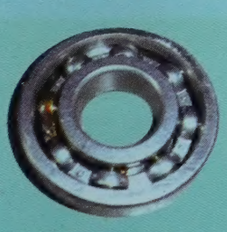


Motor

Reducer(14:1)



Motor fan



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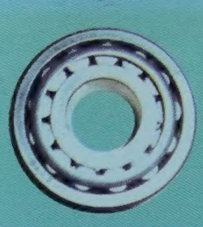

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